Sky and TELESCOPE

Miami convention exhibit

In This Issue:

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SEPTEMBER, 1956

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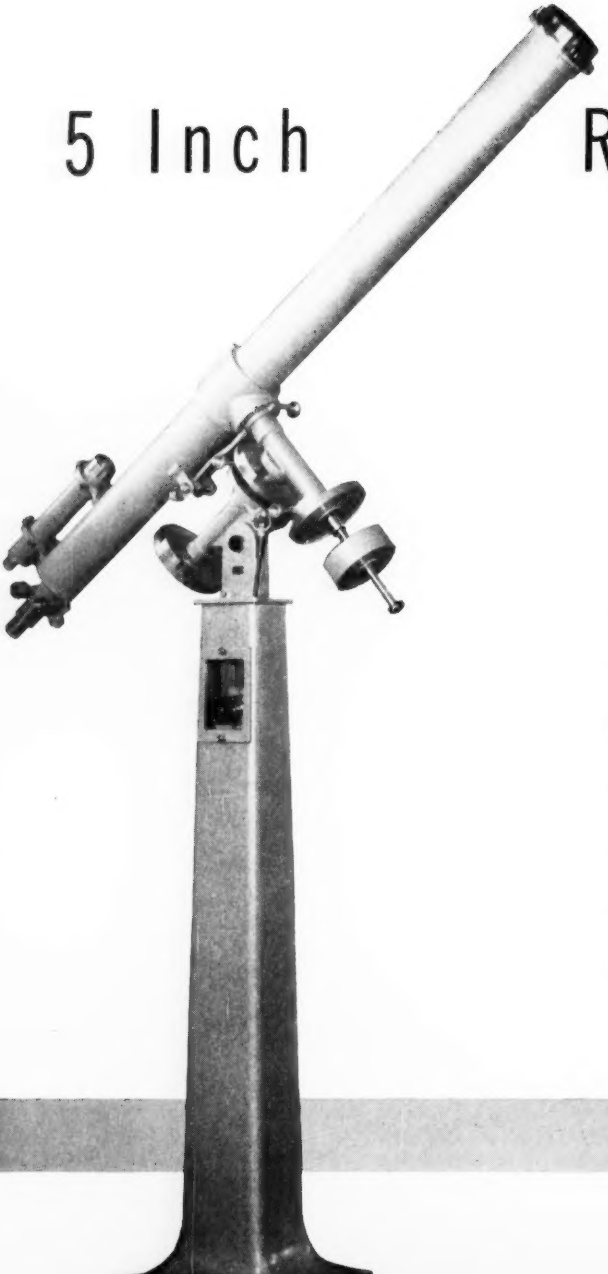

SKY AND TELESCOPE

CHARLES A. FEDERER, JR., *Editor*

JOSEPH ASHBROOK, *Technical Editor*

Vol. XV, No. 11 SEPTEMBER, 1956

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COVER: The exhibit of the Fort Lauderdale Astronomical Association at the convention of the Astronomical League, held in Miami, Fla., July 1-4, 1956. This is a black-and-white reproduction from a Kodachrome transparency by Russell C. Maag. (See page 485.)

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Editorial and advertising offices: Harvard College Observatory, Cambridge 38, Mass. Advertising manager, Henry M. Corrado. Unsolicited articles and pictures are welcome, bearing adequate return postage, but we cannot guarantee prompt editorial attention, nor are we responsible for the return of unsolicited material. Photographs should be glossy prints, minimum size 4 by 5 inches.

The principal articles are indexed in THE READERS' GUIDE TO PERIODICAL LITERATURE.

Some Technical Journals

MANY READERS have inquired recently concerning the more technical astronomical publications from which news notes and other *Sky and Telescope* material are often gathered. These inquiries show that quite a number of amateurs are interested in the details—and fundamentals—of the efforts of professionals to understand the universe.

There are not many such technical periodicals, and five of them published in America and Great Britain should give English-speaking readers a fairly complete picture of current researches. These journals are not easy to read, and many of the articles are highly mathematical. On the other hand, some papers in them are purely observational, and are sometimes illustrated with the latest photographs taken by large telescopes.

Considerable overlap exists in the subject matter of the periodicals listed here. Generally speaking, the *Astronomical Journal* deals with motions of solar system bodies, the distances and motions of stars, and with double and variable stars, excluding purely astrophysical articles. It also contains observatory reports, and summaries of papers presented at meetings of the American Astronomical Society. The *Astrophysical Journal* is largely concerned with stellar spectroscopy, but also prints many papers on clusters, galaxies, variable stars, and radio astronomy. It and the *Monthly Notices* of the Royal Astronomical Society are perhaps the most technical. The latter covers all departments of astronomy, and annually summarizes progress in the science.

The *Observatory* and the *Publications* of the Astronomical Society of the Pacific are also broad in scope. Each month the last-mentioned contains short observational reports from American observatories, and is on the average the least technical of the five.

Our list does not contain the journals of the Royal Astronomical Society of Canada and the British Astronomical Association, the *Griffith Observer*, or the *Strolling Astronomer*, as all of these are already slanted toward the amateur.

Astronomical Journal. $8.00 for 8 to 12 issues per year. Yale University Observatory, New Haven 11, Conn.

Astrophysical Journal. $15.00 for six issues in two volumes per year. University of Chicago Press, 5750 Ellis Ave., Chicago 37, Ill.

Publications of the Astronomical Society of the Pacific. $6.50 for six issues per year. 675 18th Ave., San Francisco 21, Calif.

Monthly Notices of the Royal Astronomical Society. Each issue, 13/6. For information, write Assistant Secretary, R.A.S., Burlington House, London W. 1, England.

Observatory. Six issues per year, £1. For information, write William Dawson and Sons, Ltd., Cannon House, Macklin St., London W.C. 2, England.

The University of Pennsylvania's new Flower and Cook Observatory is in Willistown township, Pa. In the 23-foot dome at the right is a 28½-inch reflector; the slide-off roof at the other end of the L-shaped building is for a 15-inch horizontal refractor. A two-car garage and the director's residence are at the left. University of Pennsylvania photograph.

Pennsylvania Symposium—"New Horizons in Astronomy"

THE DIRECTOR of a new observatory has to be something of a prophet, able to foretell the course of astronomy for years ahead. He must select equipment and decide on research programs that will enable his institution to advance with the main stream of astronomical progress, rather than be left in a backwater.

When the new Flower and Cook Observatory of the University of Pennsylvania was opened recently, its director, F. Bradshaw Wood, met this problem by holding a symposium on "New Horizons in Astronomy," dealing with the future of telescopes of moderate size, including apertures of up to 40 inches. The symposium was held in Philadelphia on June 11-12.

Previously, the University of Pennsylvania had two observatories instead of one. At the Flower Observatory, an 18-inch refractor had been used for double star measurements since 1897, but its location in Upper Darby became engulfed by the growth of the city of Philadelphia. The second station was the former private observatory of G. W. Cook, with a 28½-inch reflector and a 15-inch horizontal refractor, at Wynnewood, Pa.

Both stations have now been transferred to a new site on a 31-acre tract of land near Paoli, 500 feet above sea level, and some 20 miles west of Philadelphia, well removed from its light and smoke. The principal building is L-shaped, the dome at one end housing the 28½-inch reflector; at the other end is the horizontal refractor into which light is fed with a 24-inch siderostat mirror. A sliding roof covers the mirror and lens when they are not in use. The fixed focal point falls in a laboratory where photometers can be mounted. Other facilities include a large office and library, an electronics workshop, a darkroom, sleeping quarters, and kitchenette. Two other buildings, the director's residence and a two-car garage, complete the present establishment.

Astronomical activities at the University of Pennsylvania now center in two places. On the campus in West Philadelphia, the astronomy department offices are located in a new building for the physical sciences, including mathematics and physics. The usual laboratories and classrooms are provided, and one section of the library is devoted to astronomical publications. The school of electrical engineering is just across the street, and there is close co-operation between its staff and the astronomers. On the roof of the new building is the students' observatory, including an 8-inch Clark refractor, a 4-inch Ross-Fecker camera, and a 3-inch broken-type transit from the old Cook Observatory.

The work at Flower and Cook Observatory is centered around the application of electronic techniques to astronomical problems, principally the photoelectric photometry of eclipsing variable stars, for which the 15-inch horizontal refractor and the new Pierce pulse-counting photometer are particularly suited. The latter is a striking example of automation applied to astronomical observation, with unprecedented efficiency for variable star work.

The photometer's construction permits simultaneous observation of the variable and its nearby comparison star, eliminating the need for shifting the telescope back and forth between them. The photometer is of the pulse-counting type, and prints automatically the number of photon pulses received from the star during electronically fixed time intervals. Simultaneously, the time of the observation is printed in decimals of a day, with the heliocentric correction already included. These innovations represent a great saving in the hitherto extensive labor of making and processing photoelectric observations.

Dr. Wood's eclipsing variable program ranges from short-period W Ursae Majoris stars to supergiant systems such as Epsilon Aurigae and VV Cephei, whose periods are measured in decades. For these latter stars, Flower and Cook Observatory is taking part in an international campaign that will attempt to keep their critical eclipse phases under round-the-clock observation. Dr. Wood also keeps up to date the card catalogue of eclipsing binaries originated many years ago by R. S. Dugan at Princeton University Observatory, containing published and unpublished references to all known eclipsing stars.

W. Blitzstein, of the Flower and Cook Observatory, who completed the construction of the pulse-counting photometer, described it at the symposium. Many of the other speakers at the two-day meeting told of additional advances in observational techniques through the use of electronics.

The reach of smaller telescopes, pointed out G. E. Kron, Lick Observatory, has been greatly extended by such major advances as the charge-integration type of direct-current amplifier designed by A. J. Gardiner and H. L. Johnson (described in the *Review of Scientific Instruments*, December, 1955). In addition, greatly improved photomultipliers now being made at Paris Observatory by A. Lallemand are half a magnitude more sensitive than the best commercial tubes.

The power of these two innovations in combination was shown by recent observations of W. A. Hiltner with the 82-inch reflector of McDonald Observatory, in which he measured stars as faint as photographic magnitude 22.5—an achievement at one time possible only with the 200-inch telescope. This means that a 24-inch

reflector, provided its mirror has a fresh aluminum coating, could be used to observe 20th-magnitude stars. An immense field of useful work is thus opened up for relatively small telescopes in the measurement of magnitudes and colors of variable stars, clusters, and galaxies—data needed to straighten out the confused problem of the distance scale of the universe.

Dr. Hiltner told of his recent experiments with image converters (devices described by Otto Struve in *Sky and Telescope* for April, 1955). The Hiltner system consists of a very thin light-sensitive metal film (photocathode) from which impinging starlight liberates electrons. Emerging from the back side of the photocathode, these electrons are accelerated in an electric field before striking the photographic emulsion, where they are far more efficient than the original starlight in producing developable grains.

For this system to operate, photocathode and emulsion must be kept in a vacuum. Hitherto, the main difficulty has been that under such low pressure moisture escaped from the emulsion and reacted chemically with the cesium metal of the cathode, quickly destroying its sensitivity. Dr. Hiltner has now solved this problem by placing a thin protecting aluminum foil, less than 1,000 angstroms thick, just in front of the emulsion. Fast electrons pass practically unaffected through the foil, but water molecules find it impenetrable.

Dr. Hiltner and his co-workers at Yerkes Observatory have tested this device successfully. Seventeen days after the tube was placed in operation, the sensitivity had decreased by only 50 per cent. When attached to the telescope, the image converter has a vacuum lock, so photographic plates can be changed without destroying the vacuum. When it is desired to examine the electronically formed image visually, a phosphor-coated surface can be substituted for the photographic plate (thus restoring the image converter to its original form).

Four leaders at the June symposium were (left to right) F. Bradshaw Wood, J. D. McGee, A. Lallemand, and W. A. Hiltner, here standing near the declination circle of the 28½-inch telescope. University of Pennsylvania photograph.

Another symposium speaker, J. D. McGee, of the University of London, has made ingenious improvements in his device described on page 168 of the February, 1956, *Sky and Telescope*, and he has been experimenting with time-exposure television tubes. The latter idea is, essentially, to replace the photographic plate by a television pickup tube with a scanning rate of once or less per second, instead of 30 times as in commercial television. This method may result in the detection of very faint stars. Other progress in adapting television techniques to astronomy was reported by Peter Fellgett, of Cambridge University Observatory, some of whose results were illustrated on pages 118 and 119 of the January issue.

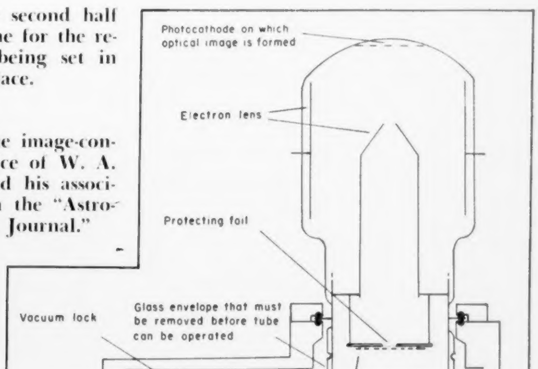
Perhaps the most spectacular accomplishment to date of the image-converter technique was shown to the meeting by Dr. Lallemand. This is the spectrogram of a 7th-magnitude *M*-type star obtained with his electronic camera attached to the spectrograph of the 47-inch reflector of Haute Provence Observatory. With only 10 seconds exposure, this spectrum shows more details than one exposed 25 times as long in the conventional manner. An important innovation was the use, not of an ordinary photographic emulsion, but of an Ilford G5 plate intended for recording cosmic rays. This has exceptionally good resolving power, and while it is a slow emulsion at room temperatures, it is very fast when cooled with liquid air.

John S. Hall, U. S. Naval Observatory, told of the growing usefulness of punched-card methods for the recording and reduction of photoelectric observations.

D. J. Lovell, Electronics Corporation of America, described a new infrared photometer, using a lead-sulfide photoconduc-

Left: The second half of the dome for the reflector is being set in place.

Right: The image-converter device of W. A. Hiltner and his associates. From the "Astrophysical Journal."



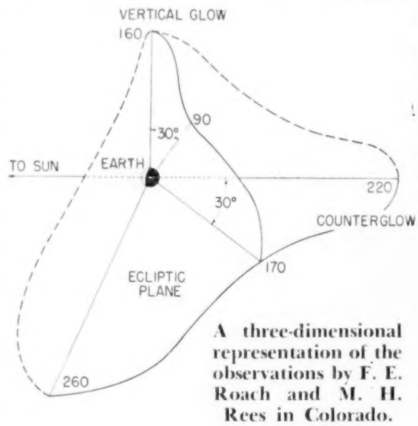
tive cell, for Harvard Observatory's 61-inch reflector. G. R. Miczaika, of Harvard, has worked with Dr. Lovell on the instrument's design. Stars can be observed in daylight, as gold-coated mirrors in the photometer absorb the intense blue light of the sky but reflect infrared radiation well.

Also featured in the symposium program were reports of new findings with more conventional equipment. One of these was an unexpected discovery by F. E. Roach, National Bureau of Standards, who has been making photoelectric observations of the zodiacal light from Fritz Peak, Colorado. With a 3-inch telescope, he obtains a tracing of the brightness of the night sky along the meridian every four minutes, and by piecing together a night's collection of these traces he can construct a map of the distribution of brightness around the sky. Suitable filters are used to remove the terrestrial air glow, and allowance can be made for starlight and scattered light.

The maps made by Dr. Roach and his colleague, M. H. Rees, therefore show the zodiacal light, extending along the ecliptic and brightest on both sides of the sun, as well as the gegenschein, a dim patch of light directly opposite the sun. But there is a hitherto unrecognized concentration of light around the pole of the ecliptic, resembling a fainter counterpart to the gegenschein. This new feature is called the *vertical glow* by its discoverers, by analogy with the English translation *counterglow* for the German term gegenschein, which is in international use.

Photoelectric techniques have brought new life to the study of the scintillation or twinkling of the stars. This phenomenon is caused when starlight encounters high-level atmospheric turbulence that produces shadow bands which move across the surface of the earth. Thus, observations of scintillation may be of direct value to meteorology. At the symposium, results demonstrating this were reported by Geoffrey Keller, Perkins Observatory, and W. Protheroe, Flower and Cook Observatory.

Dr. Keller believes that the thin atmospheric layer in which scintillation arises is at an elevation of about 10 kilometers, although some other investigators place it



A three-dimensional representation of the observations by F. E. Roach and M. H. Rees in Colorado.

higher. He uses two small telescopes, about six inches apart and pointed at the same star, to measure wind velocities and direction in the scintillation layer. Each telescope is fitted with a photoelectric cell, and the output of both cells is traced by the same high-speed recorder, using two pens.

As the star twinkles, its changing brightness appears on the recorder tape as a jagged line. The shadow band pattern reaches one telescope slightly before the other; therefore the two jagged lines, otherwise practically identical, are shifted with respect to each other by an amount corresponding to this time lag—usually some thousandths of a second. The two telescopes, rigidly mounted together, can be turned until the time lag is a maximum, and thus both the direction and velocity of the upper-atmospheric wind can be measured.

Concerning the problem of how existing telescopes of moderate size can best be employed on more traditional research, Balfour S. Whitney, University of Oklahoma, pointed out the need for more photographic observations of eclipsing variables with changing periods. Fully a sixth of the many eclipsing stars catalogued show inconstant periods, but to trace the nature of the changes, times of minimum light must be determined year after year. Photographic observations with small telescopes are very well suited for this work, in which too few astronomers are engaged.

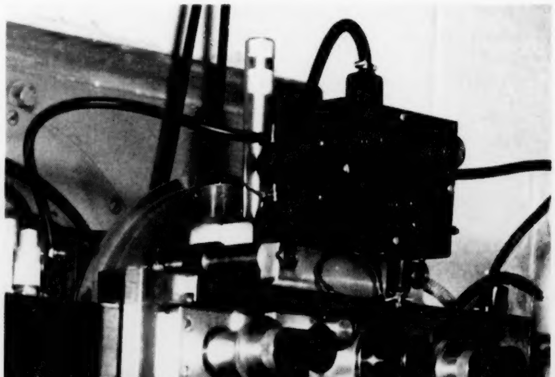
In positional astronomy, A. N. Vyssotsky, of the McCormick Observatory, called for accurate photographic proper motions of long-period variable stars, RR Lyrae variables, *R*, *N*, and *S* stars, and other special types. P. van de Kamp, Sproul Observatory, pointed out that for determining the trigonometric parallaxes of stars medium-sized long-focus refractors are as successful as larger ones. The chief need in this field is a further reduction in the systematic errors of parallax measurements, which set a limit to the accuracy of present star distances.

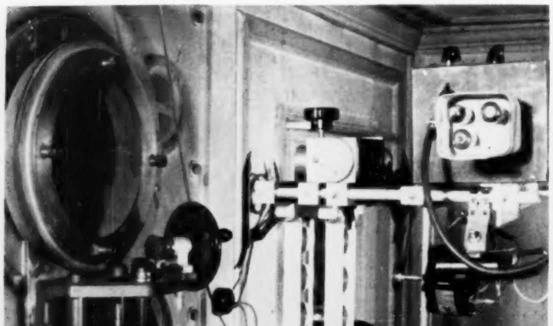
Stellar spectroscopy with reflectors of moderate aperture was discussed by D. B. McLaughlin, University of Michigan. There are many bright *B*-type stars whose spectra show emission lines that vary in intensity and structure. These, perhaps, would form the most useful spectroscopic subjects within the present means of smaller telescopes.

The symposium as a whole made clear that the distinction in accomplishment between large and small telescopes is becoming illusory. What matters for many problems is not so much the size of the telescope as the sensitivity and efficiency of the equipment used with it. Improvements now in process, powerfully aided by electronics, foreshadow a great expansion of observational astronomy in years to come.

JOSEPH ASHBROOK

Right: The Newton L. Pierce pulse-counting photometer.





Left: An experimental infrared photometer mounted at the focal plane of the horizontal refractor, when it was in the old Cook Observatory location.

☆ ☆ SKY AND TEACHER ☆ ☆

Sponsored by the
Teachers' Committee of the American Astronomical Society

A TEACHING UNIT IN ASTRONOMY — Grade 6 (Continued)

IN the July issue I outlined a guide for the teacher on the purposes, content, and activities of an astronomy class at the 6th-grade level. This installment deals with materials, books, and teaching aids for such a course. The prices shown may have changed, but they indicate relative costs.

Visual Aids

Filmstrips, 35-mm.

"What Is in the Sky," "How Our Earth Began," "About Our Earth," and "Our Earth Is Moving." In color and captioned. $3.95 each, or $12.00 for set of four strips. Educational Projections, Inc., 10 E. 40th St., New York 16, N. Y.

"The Sun," "The Moon," "The Solar System," "The Milky Way," and "Exterior Galaxies." With teaching aid. $3.25 each. International Screen Organization, 1445 18th Ave. North, St. Petersburg 2, Fla.

"A Multitude of Suns," "Stories of the Constellations," "The Sun's Family," "Interesting Things About the Planets," "Our Neighbor, the Moon," "The Changing Moon," and "How We Learn About the Sky." Captioned. $1.50 each, or $31.50 for set of seven strips. Jim Handy Organization, 2821 E. Grand Blvd., Detroit 11, Mich.

"Fun with the Stars." In color and captioned. $6.00. McGraw-Hill Text Films, 330 W. 42nd St., New York 36, N. Y.

"The Earth in Space," "The Sun and Its Planets," "Earth's Satellite, the Moon," "Comets and Meteors," "Stars and Galaxies," "Constellations," and "Work of Astronomers and Space Travel." Captioned. $3.50 each, or $21.50 for set of seven strips. Society for Visual Education, 1345 W. Diversey Parkway, Chicago 14, Ill.

Slides, 2 x 2

Slides may be ordered from Yerkes Observatory, Williams Bay, Wisc.; Lick Observatory, Mt. Hamilton, Calif.; and Mount Wilson and Palomar Observatories, California Institute of Technology Bookstore, Pasadena 4, Calif. Also from Astronomy Charted, 33 Winfield St., Worcester 10, Mass.

Titles of special sets from Blackhawk Films, Box 598, Davenport, Iowa, include: "Earth's Satellite, the Moon," "Comets and Meteors," "Constellations," and "The Earth in Space."

Films, 16-mm.

Films may be rented from your nearest film library. For 50 cents, one may purchase the booklet, *A Directory of 2660 Film Libraries*, from the Superintendent of Documents, Washington 25, D. C. The following companies offer special films, each about 10 minutes running time.

"Eclipse," and "Earth, Sun, and Moon." Almanac Films, 516 Fifth Ave., New York, N. Y.

"The Solar System." Coronet Films, Coronet Bldg., Chicago, Ill.

"The Sun," "The Moon," "The Solar System," "The Milky Way," and "Exterior Galaxies." International Screen Organization, St. Petersburg, Fla.

"The Story of the Telescope." Knowledge Builders, 625 Madison Ave., New York, N. Y.

"Exploring Space." Teaching Film Custodians, 25 W. 43rd St., New York, N. Y.

"This Is the Moon," "The Sun's Family," and "What Makes Day and Night." Young America Films, 18 W. 41st St., New York, N. Y.

Books

All About Stars, Anne Terry White. Random House, New York, 1954, $1.95.

Child's Book of Stars, A, Sy Barlow. Maxton Publishers, New York, 1953, 59 cents.

Exploring the Moon, Roy A. Gallant. Garden City Books, New York, 1955, $2.00.

Fun with Astronomy, Mac and Ira Freeman. Random House, New York, 1953, $1.50.

Golden Book of Astronomy, The, Rose Wyler and Gerald Ames. Simon and Schuster, New York, 1955, $3.95.

Stars, Herbert S. Zim and Robert H. Baker. Simon and Schuster, New York, 1951, $1.00.

Stars by Clock and Fist, The, Henry M. Neely. Viking Press, New York, 1956, $4.00.

Sun, The, Herbert S. Zim. William Morrow and Co., New York, 1953, $2.00.

Encyclopedias: *Compton's*, *World Book*, and *Britannica Junior* are suitable for astronomical topics.

Booklets

Gravity, Rowe, Peterson and Co., Evanston, Ill., 36 cents.

Sky Above Us, The, Rowe, Peterson and Co., Evanston, Ill., 36 cents.

Splendors of the Sky, Sky Publishing Corp., Cambridge 38, Mass., 75 cents.

Star Legends Among the American Indians, Book Corner, Hayden Planetarium, New York 24, N. Y., 55 cents.

200" Telescope, The, Chamber of Commerce, Escondido, Calif., 3-cent stamp.

A large listing of booklets at 10 cents each is available from the Adler Planetarium, Chicago 5, Ill.

Workbooks

Making Use of Science. Contains a unit on astronomy titled, "Studying Objects in Space." 60 cents each, or 45 cents each in quantity orders. Steck Co., Austin, Tex.

World We Live In Series, The: Book 6, Grade 6. Contains a unit on the heavens and earth. 55 cents each; less in quantity orders. Harlow Publishing Co., Oklahoma City, Okla.

Astronomical Materials

Post cards. Set of 20 on popular subjects. 75 cents. Adler Planetarium, Chicago, Ill.

15-inch globe construction kit. Shows stars to 5th magnitude and 88 constellations. Suitable for project. $1.50. Mack Hansen, 7618 LeBethon St., Tujunga, Calif.

Celestial globes. 9-inch, $14.50. Science Associates, Princeton, N. J.

Lunar map. Identifies 300 lunar objects. About 12 by 17 inches, in blue color. 25 cents each; discount on quantity orders. Sky Publishing Corp., Cambridge 38, Mass.

Meteorites. From $1.00 to $10.00. Scientific Laboratory, 2846 Oakley Ave., Baltimore 15, Md.

Model telescope kit. Model of 200-inch Hale telescope on Palomar Mountain, 1/96 scale. Easy to construct and suitable for project. (Does not make usable telescope.) $2.50. Adler Planetarium, Chicago 5, Ill.

Moon Sets. 18 large photographs with captions. May be used to construct 3-foot diameter picture of moon. $3.00. Sky Publishing Corp., Cambridge 38, Mass.

Sky Sets I and II. Two different sets, 24 large photographs in each, of solar system, Milky Way, and galaxies. Captioned. $4.00 each. Sky Publishing Corp., Cambridge 38, Mass.

Star Explorer. Revolving star chart and finder. Made of heavy cardboard. 50 cents. Book Corner, Hayden Planetarium, New York 24, N. Y.

Star Finder. Well constructed and will outlast one above. $1.50. American Nature Association, Washington, D. C.

Star Maps for Beginners. Pamphlet of monthly maps with text and with planet tables through 1960. 55 cents. Book Corner, Hayden Planetarium, New York 24, N. Y.

Monthly Star Maps. Show constellations and include section on myths of the constellations. 65 cents. Book Corner, Hayden Planetarium, New York 24, N. Y.

Telescope kit. 8-power refractor. $3.00 each; discount on quantity orders of five or more. Frank A. Meyers, 19200 N. Park Blvd., Shaker Heights, Ohio.

Spitz, Jr. Planetarium. Projects stars on ceiling or wall of darkened room. $15.00. Science Associates, Princeton, N. J.

Prism for solar spectrum. Specify prism is to be used for showing solar spectrum. From $1.25. Edmund Scientific Corp., Barrington, N. J.

J. RUSSELL SMITH
Eagle Pass, Tex.

NEWS NOTES

By Dorrit Hoffleit

TWO SCOTTISH SCIENTISTS

Scotland recently lost through death two of its most distinguished scientists, W. M. H. Greaves and Sir Edmund Whittaker. Dr. Greaves at the time of his passing was Astronomer Royal of Scotland and also professor of astronomy at the University of Edinburgh. He was president of Commission 25 on photometry of the International Astronomical Union, a past president of the Royal Astronomical Society, and one-time editor of the journal *Observatory*.

Dr. Whittaker was formerly Astronomer Royal of Ireland and a mathematician at the University of Edinburgh from 1912 until his retirement in 1946. Author of numerous mathematical treatises widely used by astronomers, Dr. Whittaker published his first book, *Modern Analysis*, in 1902. His magnum opus, *The History of the Theories of Aether and Electricity*, first appeared in 1910 and was revised by him in 1951 when he was nearly 80. He was also the editor of the late Sir Arthur Eddington's *Fundamental Theory*.

AGE OF THE EARTH

As observational data become more abundant and accurate, and as theories become more realistic, it is inevitable that estimates of the age of the earth become subject to revision. Not long ago, three billion years seemed to be the most probable age of the earth's crust, but more recent investigations indicate that the actual value is appreciably higher.

A modern method for dating rocks is by determining the relative abundances of the various isotopes of lead, as several of these are the end products from the radioactive decay of uranium and thorium. In the *Geophysical Supplement* of the *Monthly Notices* of the Royal Astronomical Society, R. D. Russell and D. W. Allan, University of Toronto, summarize isotope analyses of some 80 "young" lead ores.

They find a mean value for the time since the formation of the earth's mantle of 4.3 billion years, which agrees well with the earlier estimate by H. Jeffreys of the time since the moon began receding from the earth as a consequence of tidal friction.

Benjamin Boss, retiring director of Dudley Observatory in Albany, N. Y.

NEW SITE FOR WARNER AND SWASEY SCHMIDT

On July 7th at Montville, Ohio, ground-breaking ceremonies were held for the new Nassau Astronomical Station of Case Institute of Technology. Estimated to cost about $200,000, the new building will be located on a 160-acre site 1,250 feet above sea level, at a point said to be the highest in northern Ohio.

The station will house the 24-36-inch Schmidt-type telescope now located at the Warner and Swasey Observatory in East Cleveland. The new location is expected to prove considerably superior because of its distance from city smoke and dust. A 36-inch reflecting telescope, which is being built by the Warner and Swasey Co., will replace the Schmidt at the original observatory.

ASTRONOMICAL DYNASTY

The retirement of Benjamin Boss on July 1st from the directorship of Dudley Observatory, Albany, N. Y., closes a unique record in American astronomy—the leadership by a father and son of an important observatory for 80 years. Director for 44 years, he succeeded his father Lewis Boss, who had assumed the post in 1876.

Throughout this period, Dudley Observatory has been a major center for studies of the positions and proper motions of the brighter stars. The culmination of this long-continued effort was the publication in 1937, under the supervision of Benjamin Boss, of the *General Catalogue of 33342 Stars for the Epoch 1950*. This great five-volume work summarizes the precise position determinations, made over nearly two centuries, of practically every star in the sky brighter than magnitude 7.5. It has been invaluable in every branch of stellar astronomy.

Professor Boss was editor of the *Astronomical Journal* from 1912 until 1941, when it was acquired by the American Astronomical Society as its official publication.

Dudley Observatory is now under the joint management of Dr. Curt Hemenway, Union College, Schenectady, N. Y., and of Dr. Robert Fleischer, Rensselaer Polytechnic Institute, Troy, N. Y. Both of these astronomers will also continue their present positions.

T. E. STERNE RETURNS TO HARVARD

Dr. Theodore E. Sterne has left the staff of the Army's Ballistic Research Laboratories at Aberdeen, Md., to assume concurrent positions as associate director of the Smithsonian Astrophysical Observatory and Simon Newcomb professor of astrophysics in Harvard University.

Until 1941, when he joined the field artillery and was then transferred to the ordnance corps, Dr. Sterne had been lecturer in astrophysics at Harvard. He had specialized in astronomical applications of modern statistical methods, in problems of variable stars and of fluctuations in solar radiation.

Since 1953, Dr. Sterne has been a consultant to the U. S. Army in the management and planning of its research and development programs.

RADIAL VELOCITIES OF SOUTHERN CEPHEIDS

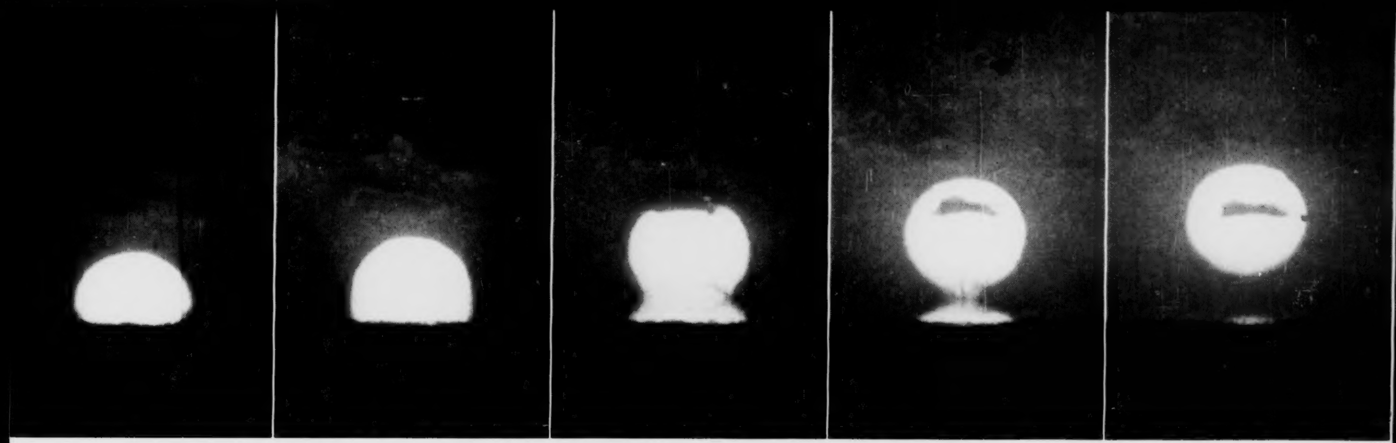
A list of the line-of-sight velocities of 55 southern Cepheid variable stars has been compiled by D. W. N. Stibbs, of Oxford University Observatory, from observations with the Radcliffe 74-inch reflector at Pretoria, South Africa. Such data are valuable for studies of galactic rotation and of Cepheid distances.

An extensive catalogue of the radial velocities of northern Cepheids had been published in 1937 by A. H. Joy at Mount Wilson Observatory, but his data for variables between galactic longitudes 230° and 325° was very scanty because that region of the sky is inaccessible to most observatories in the Northern Hemisphere.

Dr. Stibbs' list of Cepheid velocities has been published in the *Monthly Notices* of the Royal Astronomical Society. His results include stars as faint as photographic magnitude 10.5 at minimum light. The average number of observations for each star is 15, well distributed along its light cycle. Both the individual observations and mean radial velocities are given. Besides the Cepheids, 18 stars of known constant velocity were included in the Pretoria program for purposes of control. The results for them indicate that the new velocities are in close agreement with the standard Lick Observatory system.

JOINT MEETING

The American Astronomical Society will meet jointly with Section D of the American Association for the Advancement of Science, at the American Museum-Hayden Planetarium in New York City, December 26-31, 1956. Dr. Seth B. Nicholson, Mount Wilson and Palomar Observatories, will give the address of the retiring vice-president of Section D. The Helen Warner prize lecture of the American Astronomical Society is to be given by Harold Johnson of Lowell Observatory.



The rising sun and an inferior mirage, photographed by Matt F. Taggart at Ft. Lauderdale, Fla. These five exposures were taken approximately 60, 70, 120, 130, and 150 seconds after the first appearance of the sun. Mr. Taggart used a 16-mm. motion picture camera with a 6-inch telephoto lens at f/22, exposing eight frames per second of Kodachrome film. The elliptical shape of the sun's disk, due to differential refraction by the atmosphere, is conspicuous. The striking mirage was caused by a temperature difference of 28° Fahrenheit between the atmosphere and the air close to the warm ocean water. In the last three pictures, a small cloud is silhouetted on the sun.

Notes on a Convention in Miami

THE SCENE had shifted from the far northwestern part of the country, Seattle, Wash., where last year's convention was held, to the southeastern corner. The post-convention period in 1955 was highlighted by an excursion by water to Vancouver Island and the Dominion Astrophysical Observatory. This year, some 65 of the conventionites took a four-day trip to Cuba, where they visited astronomical observatories and other famous places.

Our hosts were the Southern Cross Astronomical Society, the Gulfstream Astronomical Association, both of Miami, and the Key West Astronomy Club. What Florida lacks in the size of its telescopes it makes up in the enthusiasm of its amateurs. Nearly half of those in attendance were Floridians, some of whom came from far north in the state and had never been in subtropical Miami before. Several of their faces looked very familiar, and it turned out they were amateurs of many years standing from colder climes, especially New York City, who have retired to the Southland but have not lost their interest in the stars.

The attendance from other states than Florida, according to the official register, was: Alabama, 1; Connecticut, 9; Delaware, 2; Georgia, 11; Idaho, 1; Illinois, 2; Kentucky, 2; Maryland, 2; Massachusetts, 1; Michigan, 8; Missouri, 9; New Jersey, 6; New York, 7; North Carolina, 2; Ohio, 3; Oklahoma, 1; Pennsylvania, 8; Rhode Island, 1; Tennessee, 3; Texas, 11; Virginia, 4; District of Columbia, 2; West Virginia, 1; Wisconsin, 3.

The air-conditioned McAllister Hotel was ideal for both the exhibit and the meeting sessions. There was no drowsiness with that kind of ventilation! From your room, you could see far across the water to the east and south, but the city lights and general haze were too strong for real observing.

Plenty of papers were given, perhaps too many of them in absentia, but all of considerable interest. Most dramatic was the presentation Tuesday morning of colored sunrise motion pictures by Matt F. Taggart, of Ft. Lauderdale. He has recorded little-known mirage phenomena associated with dawn; when the temperature difference between the cold air and the warm water is greatest, these effects are particularly striking.

The hall was well filled for the Taggart motion pictures (and again that afternoon for the satellite session "Zero Minus One Year"), but when the 11:00 a.m. business meeting was called to order the audience had shrunk seriously. All the officers were reelected, except for the secretary, who is now G. L. Tandy, of Independence, Mo. Miss Grace C. Scholz, Alexandria, Va., continues as president, and Mrs. Wilma A. Cherup, Pittsburgh, Pa., begins a new term of three years as executive secretary. Russell C. Maag, Sedalia, Mo., is vice president, and Chandler H. Holton, Atlanta, Ga., is treasurer.

Recipient of the Astronomical League award for 1956 was Texas' own Miss Charlie M. Noble, long a leader of astronomical activities, especially for juniors, in the Ft. Worth area. In making the

Miss Charlie M. Noble (left), Ft. Worth, Tex., is here seen with some of the junior astronomers who accompanied her to the convention. Kay Gross, standing at the right, gave a paper entitled, "Sunspots as a Research Topic." Larry Lee discussed plans for a radio telescope, while 10-year-old John Lyles (lower right) explained why he is interested in astronomy. In the center is Sherry Tyson.

At the Richmond time station, the shelter for the zenith tube camera is at the left. Its walls are ventilated, and on the roof a light frame supports a perforated moon shade, to prevent fogging the plate when the moon is high in the sky. In this latitude it can pass through the zenith.

award to her, Armand Spitz pointed out his confusion with her name when he first went to Texas to demonstrate the Spitz planetarium—he hardly expected to have to prove the merits of his instrument to a woman! Now both Ft. Worth and Dallas have planetariums in operation for the public, and there are five other installations in Texas.

Next year's convention will be held in Kansas City, Mo. At the Miami banquet, there were many levels of Missouri astronomers at the head table, including Dr. and Mrs. Harlow Shapley. The part Dr. Shapley took in the establishment of the Astronomical League is historic—he was given a special award in recognition of this and his general service to astronomy. As chief guest at the banquet, he spoke on "Fun with Planet 3." On Monday afternoon, he had given a paper on the borderland sciences of astronomy.

The small group that took a bus trip to the Naval Observatory's Richmond time station one evening, while everyone else was on an excursion boat, was rewarded in many ways. The station is out in the quiet of the country, and our eyes were already dark-adapted as we arrived. There, high in the sky, were Scorpius and his shining retinue of neighbor constellations. The Milky Way in Sagittarius was brilliant, and to the south and west stars in Lupus and Centaurus were easily identified. In a break between the palm trees that lined the southern horizon, Beta Centauri unmistakably appeared, pulsating slowly so that sometimes it was difficult to detect. This was the farthest south for many of us, but those who later went to Cuba subtracted a few more degrees from their latitude.

At the time station, the observer in charge gave us a detailed outline of the observing and reduction procedure. There are more clear nights in Florida than in Washington, and one might well say that at Richmond our time is made. There is only one instrument, the photographic zenith tube (PZT), and only one small plate (about $1\frac{1}{2}$ inches square) is taken each night. Yet on it ordinarily 88 exposures are made, four times for each of 22 stars, and from these both time and latitude can be determined with extreme accuracy. The telescope has a long-focus lens and a mirror, but the latter required not a bit of optical work, for it is merely a pool of mercury. The surface of this pool automatically lies in the astronomical horizon, at right angles to the direction of gravity, and thus the mirror always points to the astronomical zenith.

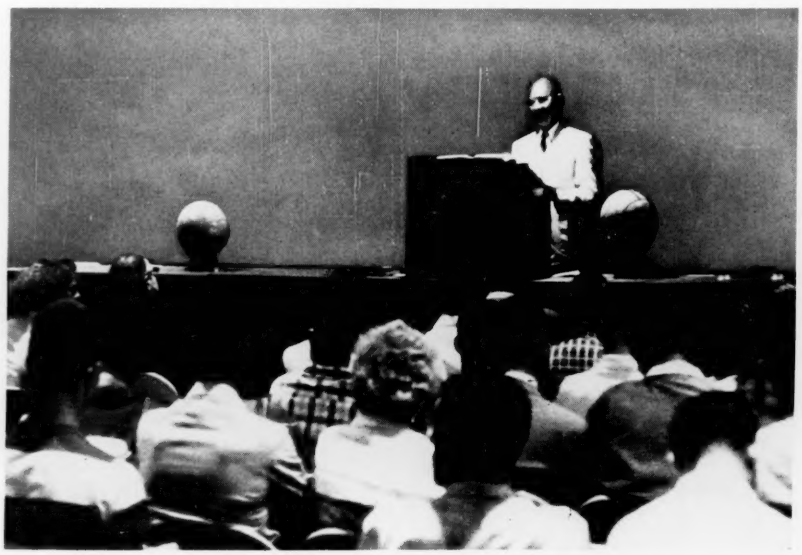
The observers say they like working at the time station. It is quite a pleasure each winter to see Orion high in the sky and no snow on the ground.

The star party on Tuesday evening in front of the bandstand did not draw many people who weren't attending the convention. It was not a good night, and Miamians know that at certain places around the city there are weekly observing sessions conducted by members of the Southern Cross society, which has telescopes permanently available for the purpose. Much of this program is the work of this writer's cousin, Carolyn Tripp, and her husband Tyrus, who for many years have been ardent amateurs, and plan some day to mount their own telescope in the rooftop observatory already provided in their home in South Miami.

Ty Tripp was exhibit chairman, and Carolyn worked on registration and hospitality; they were pretty tired at the close of the convention, as were such energetic persons as general chairman E. Downey Funck, program chairman Arthur P. Smith, Jr., and Leonard G. Pardue, in charge of publicity.

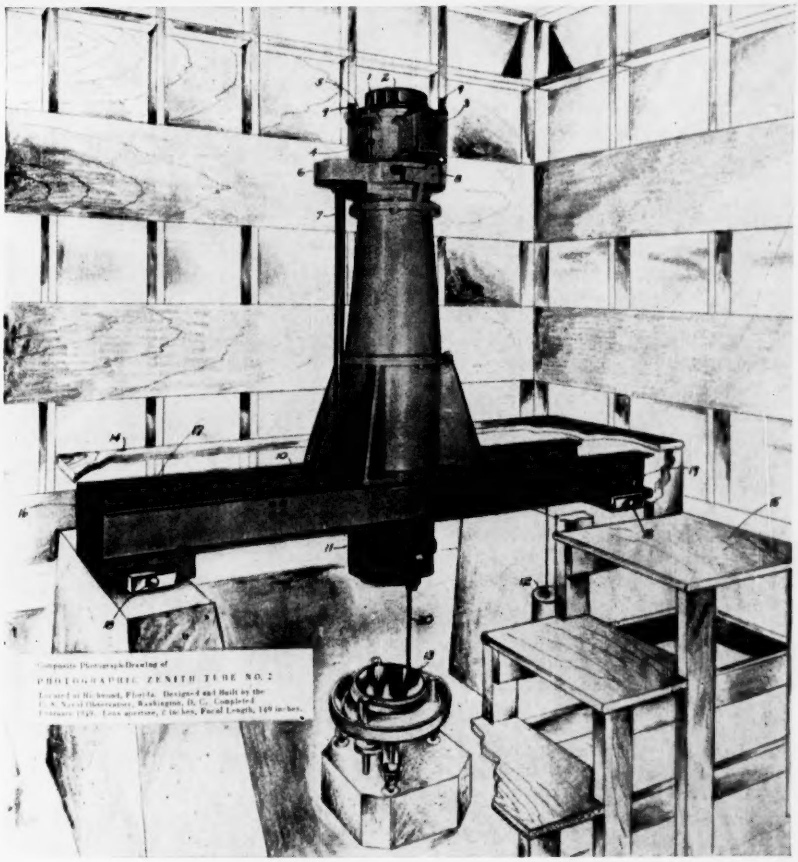
There was a considerable number of papers, mostly by absent authors, on lunar and planetary studies. Dr. James Q. Gant, Washington, D. C., was chairman of one session on observing, and Mr. Maag of the other. Observing plans for the artificial satellite came in for several hours of attention, as first-hand information was presented by three astronomers: Fred L. Whipple, director of the Smithsonian Astrophysical Observatory, J. Allen Hynek, associate director in charge of the satellite observing program, and Dr. Spitz, who is co-ordinator of visual observations of the satellite. Each gave a comprehensive talk on his part of the project and the role amateurs are expected to play.

Dr. Spitz stressed that the lone observer cannot contribute to the visual



Dr. Fred L. Whipple describes the artificial satellite project.

satellite tracking program. It has not been decided what visual instruments will be used, but G. R. Wright, chairman of the advisory committee on satellite observing, presented a number of optical instruments that were under consideration. Some of them have fields of 10 or 15 degrees, and these are looked upon with favor, as such wide fields would cut down the number of observers required in each group. One instrument shown by Mr. Wright covers 12½ degrees at a power of 5, and can show stars to about the 10th magnitude.



A composite photograph-drawing of the photographic zenith tube shows what is inside the shelter pictured on page 486. Starlight passes through an 8-inch f/18.6 objective down to a mercury basin seen in the lower part of the picture, and is reflected to a photographic plate just below the objective. The instrument was mounted in Florida in 1949. Official U. S. Navy photograph.

Dr. Hynek described the f/1 Schmidt cameras that are being designed to take photographs of the fast-moving satellite. Their aperture will probably be 20 inches. He asked for 24 capable observers to man camera stations, some in remote parts of the Western Hemisphere, as a long section of the 75th meridian will be patrolled.

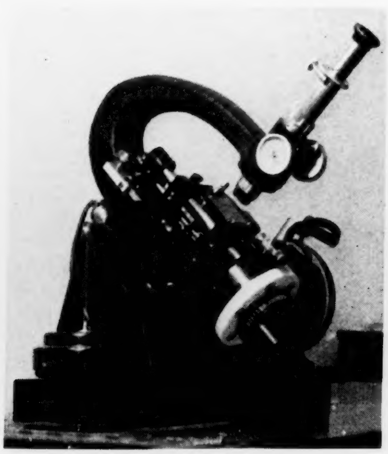
In a paper at the instrumentation session, Robert E. Cox, Cambridge, Mass., described the problem of the designations and sizes of the abrasives used by telescope makers. He pointed out the need of knowing the actual size of the average grain in each grade of grits, and suggested a new nomenclature based on the size in decimals of an inch or in microns. Professional opticians are generally using microns to express the fineness of their abrasives, but Mr. Cox believes the manufacturers could assist by having their designations on a standardized basis.

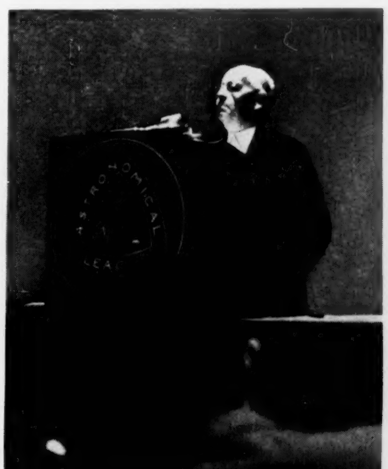
Boris Jaskovich, of the National Observatory in Havana, sent a paper on the relative merits of optical testing methods for astronomical telescopes. He ranged all the way from the "tree-leaf test," which is not good for anything, to the very accurate and objective interferometric methods. He does not recommend estimates of perfection based on the images of stars and planets, as these involve too many uncontrollable factors.

Miss Noble brought with her a number of junior astronomers, who contributed serious-minded papers to the junior program on Wednesday. The chairman of this session was Clarence E. Johnson, who has charge of junior activities for the league.

Mr. Johnson was one of the group that traveled down the East Coast from New York in the "Astronomy Special." Although they found themselves scattered through the train, it did not take long for the amateurs to locate each other. There was plenty to talk about, and few of us minded that the train was two hours late.

There was a good program Wednesday morning, the panel discussion on club projects. Of considerable specific interest was a report by Thomas L. Gibson on the Noble "telescope library" of the Ft. Worth Astronomical Society. This is a rental lending library of telescopes maintained by Miss Noble and the Ft. Worth Children's Museum. Twelve telescopes are available for rental: a 6-inch reflector, two 4-inch reflectors, eight 3½-inch re-


This precision comparator is used to measure the positions of star images on zenith tube photographs at the Richmond time station.


Clarence E. Johnson conducts the junior session.

flectors, and a small 1-inch refractor.

Most of the instruments have wooden carrying cases, from one to four eyepieces, finders, and some of them have sun projection screens. Miss Noble uses her home as the clearinghouse, maintaining the records and collecting the rentals, which are turned over to the museum for the purchase of instruments. There is usually a waiting list, and telescopes are transferred from one borrower to another without being returned to the library. Most of the borrowers pay initially for one or two months and often wish to renew. The rental rates are 50 cents a week or $2.00 a month for the smaller reflectors. The 6-inch reflector costs 75 cents a week or $3.00 a month.

Mr. Gibson had maintained the telescopes in working order. Most of his task consisted in cleaning and aligning the optics. The only optical breakage has been one finder objective, even though the library has been in operation well over two years. The optics have remained noticeably cleaner since plastic covers have been provided for each telescope, with reminder cards telling how to care for it. Instruction cards are also furnished with each instrument.

It looks as though radio astronomy is going to be a fresh field for the capable amateur. Evidence for this was the enthusiastic reception given to a talk on research trends in radio astronomy, by Dr. A. Edward Lilley, of the Naval Research Laboratory.

On the ship to Cuba Wednesday evening, July 4th, the amateurs secured permission to take deck chairs up to the topmost deck, where a very good view of the southern constellations could be had. Russ Maag reports that this observing session lasted until three o'clock in the morning and that many new star groups were seen by the northerners.

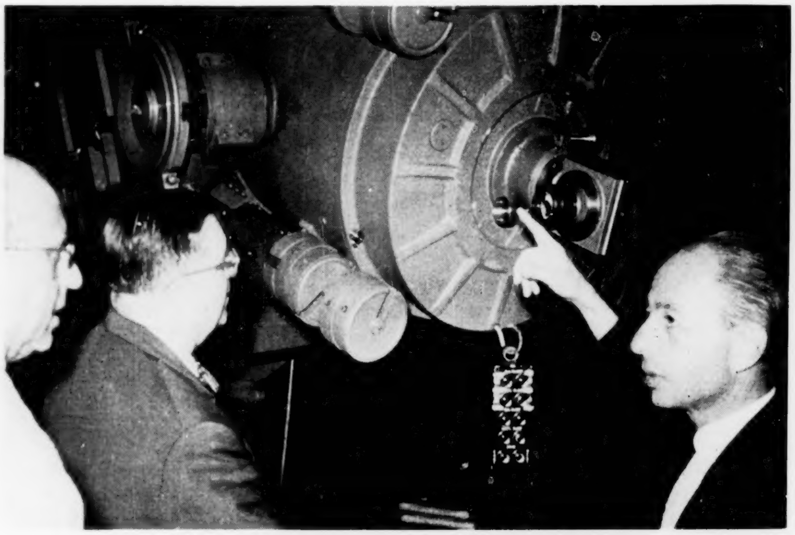
The Cuban Navy rolled out the red carpet, providing transportation, refreshments, and generally making the Americans feel at home. A reception committee of naval officers and personnel from the Cuban national observatory had met our group on the ship at Havana. During the first evening in Cuba, there was an informal reception by Admiral José E. Rodriguez Calderon, chief of staff, Col. Guillermo Driggs Guerra, director of the naval academy, and Dr. José Carlos Millas, director of the national observatory. The crowd that gathered to hear Dr. Shapley talk was too large for the observatory lecture hall, so the screen and projector for his slides were set up outdoors under a cloudless tropical sky. The observatory's 10-inch Brashear refractor was later used for observing.

G. L. Tandy, secretary-elect of the Astronomical League, is standing beside the largest telescope in the convention exhibit. It was made by Lynn H. Collar, of Miami. It has a heavy fork mounting and many refinements and special controls. (Another part of the exhibit is shown on the front cover of this issue.) Photograph by Russell C. Maag.

On their second day, the visitors were taken to the naval training station at Mariel, some 40 miles from Havana. Art Smith reports a luncheon of "exotic fruit cocktail, soup, chicken and yellow rice, served with a magnificent beer, topped off with a dessert of guava shells and cream cheese, and a demitasse of fine Cuban coffee." At this time, Sr. Eladio Vargas, unofficial head of the Cuban amateurs, stated that steps were already under way for them to join the Astronomical League as its 105th society.

On a farm in the outskirts of Havana, Dr. Miguel Mery, a specialist in eye diseases, has the largest telescope in Cuba. It is a brand-new 24-inch Fecker Newtonian-Cassegrainian, equipped with push-button controls. He also has a 4-inch Fecker Schmidt camera with which he has taken many photographs of celestial objects. Dr. Mery is active in solar, planetary, and variable star observing, and desires to correspond with other amateurs; his address is San Miguel 955, Havana, Cuba. He showed the visitors slides of his pictures, and late in the evening the sky cleared for observing.

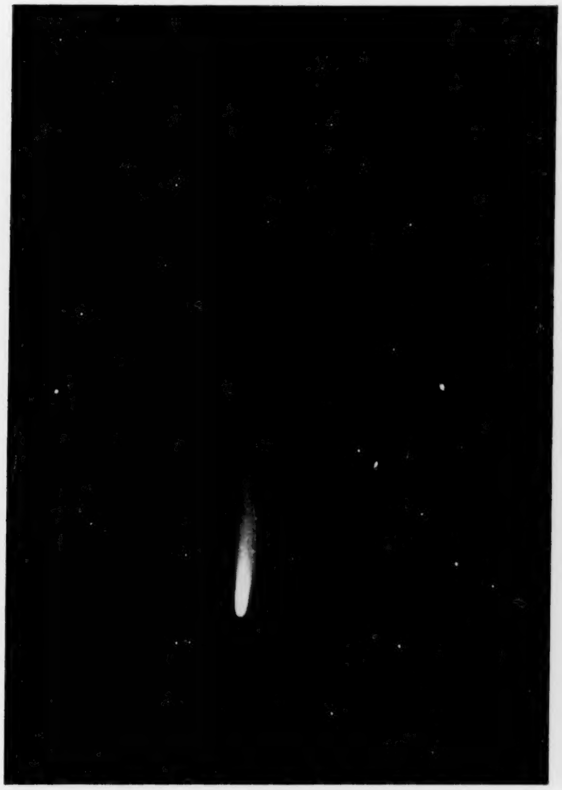
Other institutions visited in Cuba were the meteorological observatory at Belen College in Marianao, which has a 4-inch refractor, and a 6-inch installed there to observe the transit of Venus in 1882; the University of Havana in the city itself, which has a 6-inch refractor; and La Salle College, which has a new Spitz planetarium projector in an air-conditioned chamber. The private observatory of Sr. Santiago Abascal is atop his home, and has a 6-inch Mogey refractor under a dome. This instrument is regularly used by his scientifically minded daughters (both with Ph.D.'s). C. A. F.



The Cuban trip included a visit to the observatory of Dr. Miguel Mery (right), who is showing his 24-inch reflector to Dr. James Q. Gant, Washington, D. C., while Dr. Boris Jaskovich, National Observatory of Cuba, looks on. Photograph by Russell C. Maag.

The Spectra of Comets

OTTO STRUVE
Leuschner Observatory
University of California



Comet 1948 I, the finest of recent years, was first seen during the total solar eclipse of November 1st that year. This photograph was taken on November 13th by Estaban Rondanina at Montevideo Observatory in Uruguay.

THE COMETS present some of the most interesting of the unsolved and half-solved problems of the solar system. Astronomers are now beginning to understand the physical nature of comets, and the sometimes spectacular changes they show, with the aid of powerful astrophysical methods, both observational and theoretical. Among these methods, spectroscopy plays a leading role in unraveling the puzzles of the comets.

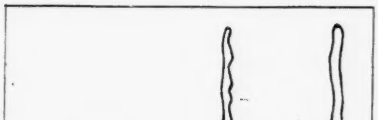
The Astrophysical Institute of the University of Liège, Belgium, has recently published a large *Atlas of Representative Cometary Spectra*. The authors of this monumental work are the Belgian astronomer Dr. P. Swings, chairman of the International Astronomical Union's commission on the physics of comets, and the German physicist Dr. L. Haser. The need for such an atlas had been stressed at both the 1948 Zurich meeting and at the 1952 Rome meeting of the union. The work was finally completed through the co-operation of many observatories, and with financial support from the Geophysics Research Directorate of the Cambridge Research Center, U. S. Air Force.

The authors point out that there are some good reproductions of cometary spectrograms scattered through astronomical literature. But, as a rule, the accompanying discussions refer to single comets and their individual characteristics.

No systematic attempt had been made previously to collect in one volume the spectra of many different comets, observed over a wide range of distances from the sun. There had not been any systematic comparison of the various spectra, to find those features common to all comets and those that differ markedly from one object to another. Swings and Haser collected from several observatories 350 spectrograms of 36 comets (counting each apparition of a periodic comet as a separate object), and selected numerous spectra of 30 of these comets, from the years 1899 to 1952, for reproduction in the atlas.

The text contains descriptions of the spectra, and—what is especially valuable—a comparative study of the entire material.

A comet's nucleus is a solid body or group of solid bodies, about one kilometer in diameter and consisting of a loose agglomeration of frozen gases and metallic grains. The average density of this "dirty iceberg," according to F. L. Whipple, may be about 0.05 gram per cubic centimeter, which implies a very porous structure, with the spaces between the icy masses occupying about 95 per cent of the volume. From this nucleus come the molecules and solid particles that later form the head of the comet and the tail.



The parts that compose a typical comet are shown in this sketch from Fletcher G. Watson's book, "Between the Planets." The direction of the tail is usually away from the sun, because its very minute particles are repelled by the pressure of solar radiation.

The nucleus itself can be observed only if a comet happens to come relatively close to the earth. But its existence is perhaps most convincingly demonstrated by the great comet of 1882, which passed at perihelion through the corona of the sun, within 300,000 miles of its surface, and remained for several hours within 1/200 astronomical unit from the sun.

At this time, therefore, each square inch of Comet 1882 II was receiving $(200)^2 = 40{,}000$ times as much heat as a corresponding area of the earth's surface. Both comet and earth reradiate the energy they receive from the sun, at a temperature proportional to the fourth root of the rate of radiation—according to Stefan's law. Since the surface temperature of the earth is about 300° absolute, the temperature, T, of the comet can be calculated from

$$T/300 = \sqrt[4]{40{,}000}.$$

This gives 4,200° for the comet's temperature—high enough to evaporate any *small* bodies if subjected to this temperature for several hours. But the nucleus of Comet 1882 II did not disappear; instead it broke into several parts from the intense heat and the tidal force of the sun, but each fragment remained visible until it was lost to sight by its increasing distance.

As a comet approaches the sun, the nucleus begins to exhale molecules of

various kinds. These are called the *parent molecules* and are not observed directly because the light that they emit lies in unobservable regions of the spectrum. One of these parent molecules may be ammonia, NH_3, whose absorption features are well known in the atmospheres of Jupiter and Saturn, but whose strongest bands are not observable in comets. What we actually observe is an incomplete molecule or *radical*, NH_2, formed when ammonia has lost one hydrogen atom, due to photodissociation by sunlight. We can also detect NH, which has lost still another hydrogen atom.

These radicals are observed as emission bands in a tenuous halo—the head or coma of the comet—which surrounds the nucleus. The head also shines by reflected sunlight, especially in its inner portions. Thus the spectrogram of a comet head shows a narrow strip of reflected solar spectrum, on which the emission bands are superimposed.

The Doppler shifts of the absorption lines in the reflected solar spectrum record the combined effects of the motion of the comet with respect to the sun and to the earth. The emission bands, produced in the comet itself, show only the line-of-sight motion of the comet relative to the earth.

The principal molecules observed in the head are OH, NH, CN, CH, C_3, C_2, and NH_2. All consist of relatively abundant elements. When a comet comes within 0.7 astronomical unit of the sun, it usually shows the yellow emission lines of atomic sodium (D_1 and D_2). When Comet 1882 II had a solar distance of 0.1 A.U., emission lines of iron and nickel atoms were observed. None of the comets in the atlas exhibits these lines of Fe and Ni, but several show the sodium lines.

The gases that evaporate from cometary nuclei are so rarified—about a million molecules per cubic centimeter—that collisions between the molecules are unimportant. There are two possibilities: these gases radiate either because they are excited by sunlight or when they collide with particles streaming from the sun. In the former case we would describe the emission as fluorescence, in the latter as due to collisional excitation.

The authors of the atlas present a strong case for fluorescence as the dominating mechanism. However, one kind of cometary radiation may be caused by collisional excitation. A cometary band at 4050 angstroms—now attributed to the molecule C_3—is produced in the laboratory in the presence of hydrogen. Since the clouds of solar corpuscles that produce auroras consist mainly of protons, it is plausible that these clouds, on colliding with comets, cause the 4050 emission bands. On the other hand, the structure of these bands in different comets is quite similar, whether the solar activity at the time of each observation was great or small.

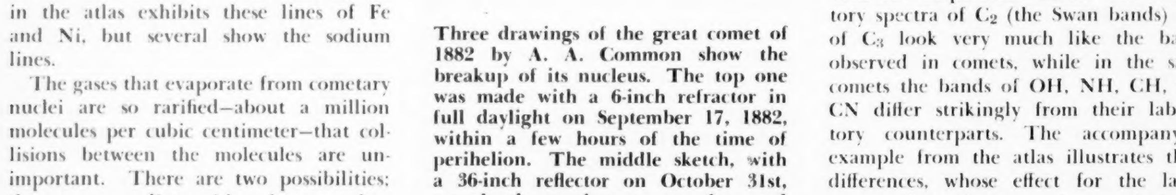
The characteristic step-by-step drop in intensity of the successive individual lines that form a molecular band is an indicator of the temperature of the gas in the laboratory. In effect, the intensities of the lines are proportional to the numbers of molecules in various energy states; and these numbers in turn depend upon the temperature. When this method is applied to the molecular bands of comets, the temperatures obtained from molecules composed of atoms of a single element, such as C_2, turn out to be about 3,000°; molecules like OH, made of more than one element, give only 50°.

This marked inconsistency is explained by the rarity of collisions between the molecules. They are too infrequent to equalize the kinetic energies of the different particles, as they do in a laboratory gas, which would bring about a statistical distribution of the molecular velocities described as Gaussian or Maxwellian. Each species of molecule is acted upon by sunlight in a manner characteristic of the species alone, so the energies of the molecules, taken in bulk, cannot logically be described by the thermodynamic concept of temperature.

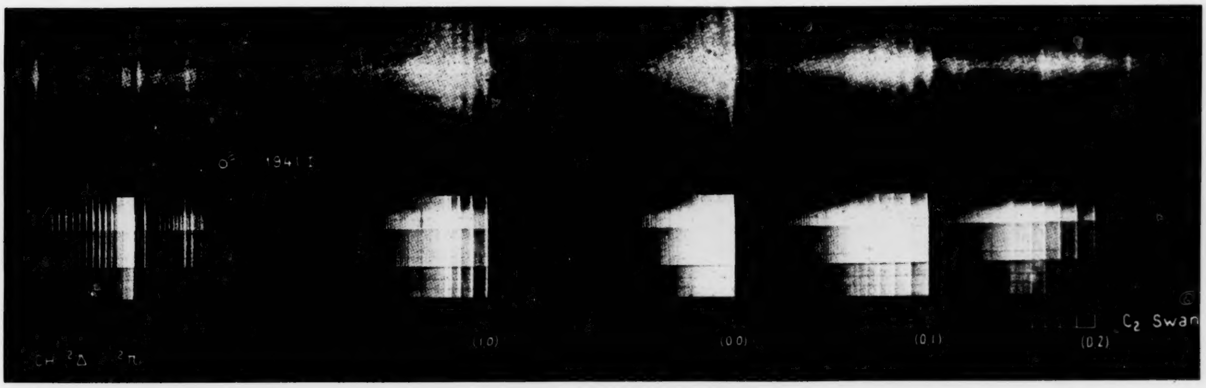
Observationally, this apparent difference in temperature makes the laboratory spectra of C_2 (the Swan bands) and of C_3 look very much like the bands observed in comets, while in the same comets the bands of OH, NH, CH, and CN differ strikingly from their laboratory counterparts. The accompanying example from the atlas illustrates these differences, whose effect for the latter group of bands is to give much lower temperatures for comets than for the acetylene flame used as the laboratory source.

The importance of fluorescence in the production of comet bands was first fully recognized by Swings. He showed not

Three drawings of the great comet of 1882 by A. A. Common show the breakup of its nucleus. The top one was made with a 6-inch refractor in full daylight on September 17, 1882, within a few hours of the time of perihelion. The middle sketch, with a 36-inch reflector on October 31st, reveals the nucleus as an elongated but interrupted band. Finally, the drawing of January 27, 1883, also with the 36-inch telescope, shows five nuclei, widely spaced along a line. The two brightest appeared of the 11th magnitude. From the "Monthly Notices" of the Royal Astronomical Society.



These two spectra of the eclipse comet of 1948 are reproduced as positives, instead of negatives as in the Swings-Haser atlas. The upper one (flanked by laboratory comparison spectra) was obtained by J. Sahade at Cordoba Observatory, when the comet was 0.52 astronomical unit from the sun; the lower is from McDonald Observatory, when this distance was 0.65 unit. The bright strips are reflected sunlight from the central part of the head, and are broken by dark solar absorption lines. At the extreme left is the cometary CN band (wave length 3883 angstroms); at the extreme right, the 4737 band of C_2. C_3 is also present, about $1\frac{1}{4}$-inches from the left (violet) end of the lower spectrum. All spectrograms with this article are from the new "Atlas of Representative Cometary Spectra."



To compare the spectra of comets and flames, Swings and Haser use Comet Cunningham (upper spectrum) when it was 0.73 astronomical unit from the sun, and laboratory spectra showing the Swan bands of the C_2 molecule. The correspondence with the comet spectrum is generally good. The CH bands at the left, however, appear quite different in the comet and flame.

only that the relative intensities of the component lines of the CN bands indicated a low temperature, but that there were intensity anomalies that could not be explained by any temperature. Some lines were either missing or very weak, though neighboring lines had normal intensities. Whenever a cometary line was thus abnormally weak, Swings noticed that in the solar spectrum there was a strong absorption line at the same wave length. Therefore, the comet received insufficient light from the sun at the wave length required to raise a CN molecule into some particular energy state. And without the necessary solar radiation, there resulted too few CN molecules with the proper energy for producing the emission line at normal intensity in the comet's spectrum.

But in a few comets, the relative motion of comet and sun was so large as to enable the comet to "see" not the depleted light of the absorption line, but a neighboring bright part of the solar continuous spectrum. In these comets there was no anomalous weakness of this line, in full accordance with Swings' interpretation.

Spectra of comet tails contain only reflected sunlight and bands of ionized molecules: CH^+, OH^+, CO^+, CO_2^+, and N_2^+. The ionization is an understandable result of solar radiation and low gas pressure in the tails.

The authors of the atlas found, in comparing the spectra of the same comet at different times, or even in comparing different comets, that the most useful criterion is the distance of the comet from the sun. As we have seen, it is this quantity that defines the amount of solar radiation reaching a square inch of the surface of the comet. Swings and Haser also looked into the associated question: Does the duration of time for which a comet is exposed to strong solar radiation affect the spectrum? It might have been expected that a periodic comet, always relatively near the sun, would have lost much of its more volatile constituents by solar heating, while comets moving in larger orbits would not have suffered such effects.

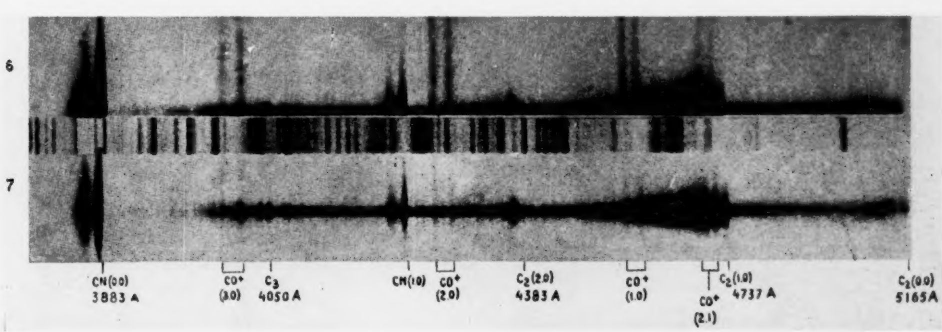
The answer to this question was largely negative. There was no essential spectroscopic difference between periodic and nearly parabolic comets. Neither was there any detectable difference between the spectra of comets before and after their perihelion passages. (Unfortunately, no individual comet had been observed spectrographically both before and after perihelion: the test therefore rests on a comparison of the spectra of *different* comets observed at about the same distance from the sun.) Nevertheless, the total energy received by a comet depends strongly on its perihelion distance; a comet which comes close to the sun accumulates much more heat than one whose perihelion distance is large. Hence, if there were any pronounced effect, it would have shown up even in a comparison of comet spectra all taken after perihelion, if some of these comets had small and others large perihelion distances.

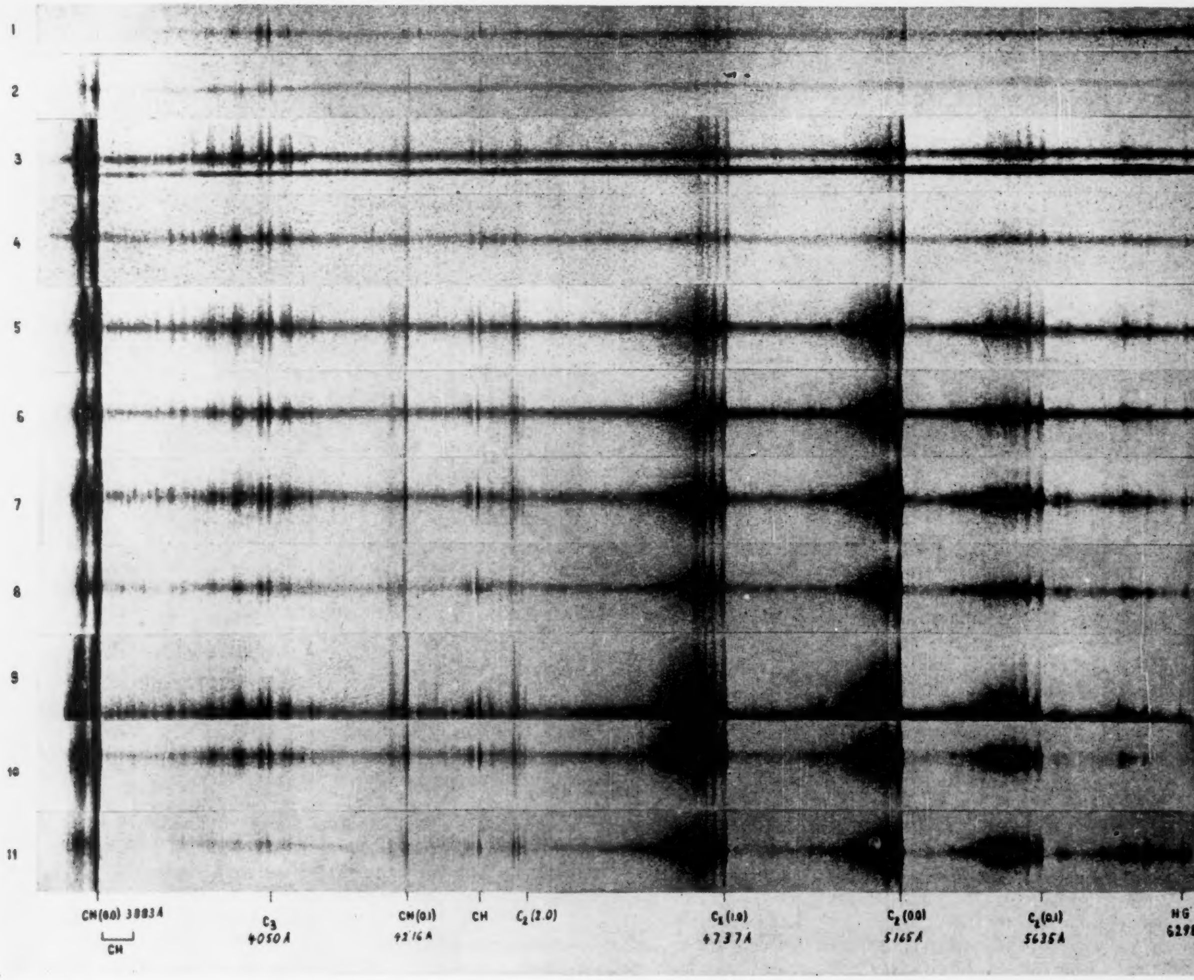
While distance from the sun is the chief factor in determining the appearance of a comet spectrum, this does not mean that different comets have identical spectra when observed at the same heliocentric distance. Each comet has its own characteristics, which are not directly traceable to the past history of the comet, but probably to its initial chemical composition. This, perhaps, is the most important result of the Swings-Haser comparisons.

The authors of the atlas believe that the two elements whose relative abundances differ most from comet to comet are carbon and hydrogen. "This," they suggest, "may possibly lead to the discovery of 'genetic families' of comets of different chemical composition which may have originated either in the original solar nebula, or in proto-Jupiter, proto-Saturn, etc."

Ordinarily, at heliocentric distances greater than three astronomical units the spectra of comets show only the reflected light of the sun. At 3 A.U., the bands of CN first appear, but a few comets have shown only solar reflection spectra even at distances less than 1 A.U. The "eclipse comet," 1948 l, was one of these exceptional cases. Two of its spectra, made

Two spectra of Comet 1911 V (Brooks), taken directly from the Swings-Haser atlas, where they are negative prints (bright spectrum lines appear dark). No. 6, the upper spectrum, has only part of the head along its lower edge, and part of the tail extends upward from it. Note the CO^+ bands of the tail.





These slit spectrograms, made with the 82-inch McDonald Observatory reflector, show how the spectrum of Comet Cunningham altered as its distance from the sun decreased. Especially, the emission bands (dark on this negative reproduction from the Swings-Haser atlas) gain in prominence relative to the continuum of reflected sunlight extending along each spectrum. For spectra 1 to 11, the heliocentric distances were, respectively, 1.16, 1.14, 1.01, 0.99, 0.85, 0.73, 0.71, 0.69, 0.67, 0.57, and 0.52 astronomical units.

when the distance from the sun was 0.52 and 0.65 A.U., are shown on page 490.

The principal emission bands may be compared with those of Comet 1941 I (Cunningham) in the accompanying picture, showing the development of the spectrum of the latter comet as it approached the sun. The heliocentric distance was 1.16 A.U. for the top spectrogram and 0.52 for the bottom one.

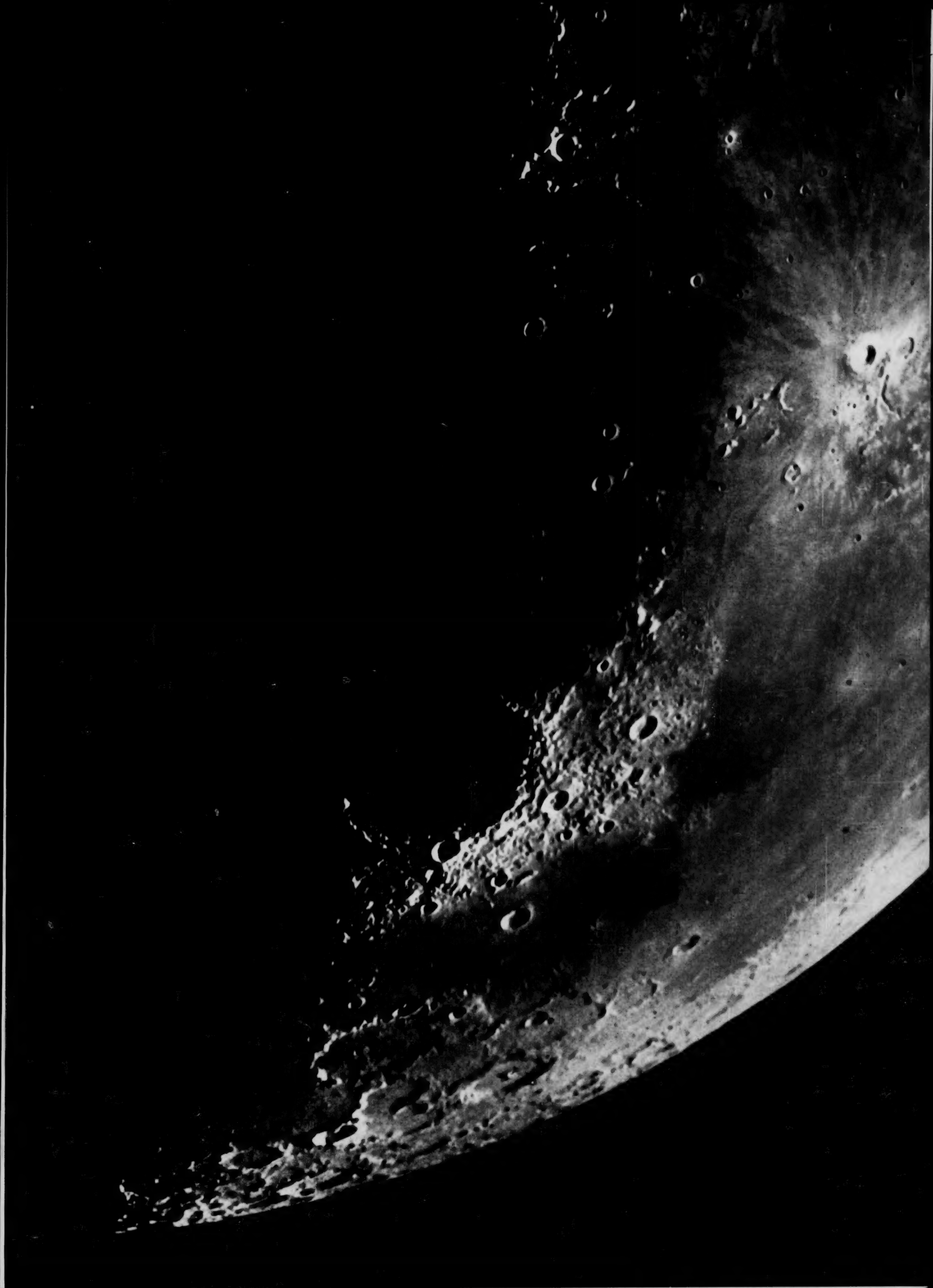
Three significant features will be noticed. First, the bands of CH are short and stubby, while those of CN and C_2 extend along the entire length of the spectrograph slit. This means that the CH bands are visible only in the central part of the head. Second, as the comet nears the sun, the C_2 bands become stronger relative to those of C_3. Third, between those of C_2 at 5165 and 4737 angstroms there are several unidentified emission bands. These and other unidentified features are a challenge to molecular spectroscopists and astrophysicists alike.

Swings and Haser have also searched for a correlation between the spectrum and the absolute magnitude of a comet—the apparent magnitude that the comet would have if both its heliocentric and geocentric distances were one astronomical unit. It was found that the intrinsically very luminous comets tend slightly to show a stronger solar reflection spectrum than do the fainter comets. The more luminous comets are presumably the ones that have been least dispersed by solar heat and tidal action.

There is a more marked relation between orbital period and intensity of reflected sunlight. Comets with nearly parabolic orbits have a pronounced tendency to show a strong continuous spectrum at great distances from the sun. For other comets, with periods of 100 years or more, there is no relation between intensity of the continuous spectrum and period, irrespective of heliocentric distance. Comets with periods shorter than 10 years show a strong continuum, but Encke's comet is a startling exception: despite its period of only 3.3 years, it shows almost no reflected sunlight.

These indications of correlations are not sufficient to clarify fully the processes that make the comets what they are. But they most certainly point ways that future observers will explore with much profit.

FACING PICTURE: The northern tip of the waning crescent moon, aged 24.3 days, enlarged from a negative of August 20, 1938, taken by J. H. Moore and J. F. Chappell with the Lick Observatory 36-inch refractor. This concludes the series of eight sectional views that began in the February issue. The great semicircular bay below the center is Sinus Iridum, fringed by the Jura Mountains. Near the picture's upper right edge is the brilliant crater Aristarchus, center of a ray system. Just below it and to the right is the curving Schroter's Valley.



Swift's Forecast of Mars' Satellites

HENRY C. BRINTON

ALTHOUGH the news of Asaph Hall's discovery of the two moons of Mars took the scientific world of 1877 by surprise, it had a stranger effect on the world of literature. For the data compiled by Hall from his actual observations of the satellites were strikingly similar to those of a fanciful passage in *Gulliver's Travels*, a satirical account of the voyages made by an English sailor.

This imaginary travelogue was written by Jonathan Swift and published in 1726; it included a chapter that made particular fun of mathematicians and scientists of Swift's time. The scene upon which the passage is founded is the amazing flying island of Laputa. Swift describes the marvelous state of Laputan learning, and says:

"They have . . . discovered two lesser stars, or satellites, which revolve about Mars, whereof the innermost is distant from the centre of the primary planet exactly three of the diameters, and the outermost five; the former revolves in the space of ten hours, and the latter in twenty-one and an half . . . ."

Here is how the data compare:

Satellite	*Distance from Mars' Center* Swift	Hall	*Period of Revolution* Swift	Hall
Inner	3 diam.	1.38 diam.	10 h.	7 h. 39 m.
Outer	5 diam.	3.46 diam.	21½ h.	30 h. 18 m.

The rough numerical correspondence between the pretended data of the Laputan astronomers and the properties of the true satellites is striking. But this is not all. Swift's satellites also move in accord with Kepler's third law. When applied to several moons of the same planet, this law states that the ratio of the cube of the distance to the square of the period must be the same for all of them. And indeed, this ratio is 0.27 for both of Swift's satellites, with the units used in the table.

What was the background behind Swift's statement that Mars was attended by two moons, when the actual existence of such bodies was not detected for another century and a half? When the fictional writings that Swift may have used as sources are considered, there is not one that could be a probable basis for such an idea. A generation later, in 1752, Voltaire published his fantasy *Micromegas*. Just as Swift's book had been in part, this latter work was concerned with the happenings and relationships when people of vastly different physical dimensions are brought together. *Micromegas* is, in fact, a description of the interplanetary wanderings of two 18th-century spacemen.

Voltaire wrote of the travelers coasting in space about Mars: "They have described two moons subservient to that orb which have escaped the observation of all our astronomers." Seeming to realize that reference to these moons would stir up doubt in the minds of his readers, Voltaire wrote later in the same book, "I entirely refer myself to those who reason by analogy. Those worthy philosophers are very sensible that Mars, which is at such a distance from the sun, must be in a very uncomfortable situation, without the benefit of a couple of moons."

It has been suggested that Voltaire borrowed this theme from Swift's satire, which was quite well known and widely read. But Voltaire, a brilliant man, was greatly interested in physics, especially in Newtonian theory, and he was known to enjoy astronomical observations with opera glasses. He performed numerous experiments in his home physics laboratory. Yet while it seems that Voltaire himself was not incapable of originating the theory of the Martian satellites, it appears more likely that his material was derived from that of Swift.

During the closing years of the 17th century, Swift was employed as a secretary by the English gentleman Sir William Temple. In 1692, the latter published his essay *Upon Ancient and Modern Learning*, bringing to the British Isles a controversy which had been introduced in France by the writer Bernard le Bovier de Fontenelle. This work and criticism of it by William Wotton caused Swift in 1697 to write his well-known *Battle of the Books*.

Fontenelle wrote a book in 1686, *Entretiens sur la Pluralité des Mondes*, in which he popularized certain astronomical theories; this became one of his most famous works. Its pages contain detailed discussions on each of the members of the solar system, and the following passage is included in the description of Mars, "Nor has he any Moon to wait upon him, and in that, as well as Mercury and Venus, he must acknowledge himself our inferior." Voltaire was also acquainted with Fontenelle's writings, using the latter's astronomical text as a handbook for his celestial observing. But we see here that neither Swift's nor Voltaire's ideas on Martian satellites can be traced to this work of Fontenelle.

As for research of his own, the very nature of Swift tells us that he was not a scientist. At no time was he occupied with scientific pursuits, and his references to men of science are ones of satire—not of brotherhood. Thus, we must turn to the possibility that the whole idea of Martian moons sprung from Swift's imagination, and that he quite unknowingly made a prediction that later came true. He drew the people of Laputa as a superstitious, mentally disturbed group, without definite power of action, and dominated by thoughts of a mathematical nature. With these gross exaggerations of what he believed to be the fundamental nature of scientists, Swift wove his deep-cutting satire into a clever, readable story.

Among Swift's sources were the *Philosophical Transactions* of the Royal Society, which kept pace with contemporary science, and from them he incorporated many ideas into his own works. The humorous analogies between music and mathematics in the "Voyage to Laputa" were not founded on pure fantasy, for they reflected and enlarged upon the attitudes of the mathematicians Descartes and Newton.

Swift described the Laputan astronomer's cave as a sunken area where a "great variety of sextants, quadrants, telescopes, astrolabes and other astronomical instruments" were stored. He is believed to have based this description on his own visit to the Royal Observatory in Paris. This institution had just such caves for laboratory experiments.

Everything considered, it seems reasonable to attribute Swift's Martian satellite prediction to pure chance. After all, was it not logical that Mars have two moons since its neighbors, Earth and Jupiter, had respectively one and four? It was logical, too, that these bodies be governed by Kepler's laws. Realizing this, Swift had merely to plug into his selected distance-period ratio some convenient values, and the others would work out for themselves.

Nevertheless, there is a great likelihood that someone before Swift's time had thought of the possibility of moons around Mars, and it is even said that in 1610 Johannes Kepler suggested the number of these bodies as two. Therefore, we may not safely give all the credit to Swift, even though he solidified in *Gulliver's Travels* any previous speculations of this nature.

How surprised old Jonathan Swift would have been had he stood at the side of astronomer Asaph Hall on that night in 1877! He would have realized then that his Laputan science was not pure satire after all!

ASAPH HALL

and the Moons of Mars

JOHN T. KANE

Asaph Hall (1829-1907), who began his career as a carpenter, became an outstanding American astronomer of his time, famed for his discovery of the Martian satellites and for his double star observations.

As MARS pulls up to a neighborly 35,200,000 miles this month, it is interesting to look back to the close opposition of the red planet in the late summer of 1877. Then the two satellites of Mars were discovered at the U. S. Naval Observatory by Asaph Hall, a carpenter who rose to be one of the most noted American astronomers of the 19th century.

The telescope Hall used, a 26-inch refractor which was one of the largest instruments of that time, is still in use at the Naval Observatory. It has long been overshadowed by the giant reflectors, and the growth of metropolitan Washington has limited the occasions for good observing. Nevertheless, for the past year or so Dr. John S. Hall, head of the equatorial division at the Naval Observatory, has been using the 26-inch to test experimental image-converter equipment. Some of this work has been in collaboration with Dr. W. A. Baum, of Mount Wilson and Palomar Observatories. One result of their experiments with thin-film image-converter photography may be better observations of Mars.

Born in Goshen, Conn., in 1829, young Asaph Hall saw his family fortunes deteriorate to the point where he could receive only a few years of elementary schooling before he was apprenticed out as a carpenter—a trade in which he became quite skilled. But at the age of 24 he heard of a tiny college with strong abolitionist sentiments in McGrawville, N. Y., that offered an education to just about anybody who wanted one.

Interest in astronomy and ability in mathematics led the former carpenter from McGrawville to the University of Michigan and thence to Harvard. He managed to obtain a position at the Naval Observatory, beginning his career there in 1862—just when the city of Washington was an armed camp in the Civil War. President Lincoln and Secretary of War Stanton often visited the observatory, then located near the present site of the Lincoln Memorial.

One night during the war, while Hall was alone at the observatory, he heard a knock on the trapdoor leading up to the telescope dome. He opened the door to find Abraham Lincoln. The president said he had a question that had puzzled him for some time: "Why does the moon appear inverted in a telescope?" The bloodshed between the North and South must have seemed far away while the war-weary president listened to the astronomer explain the optical factors involved in telescope construction.

Asaph Hall was a man who had struggled against poverty and hardship for many years to become a professional astronomer. He seems to have developed a skeptical turn of mind, even to questioning some of the astronomical statements common at that time. This is evident in the account of his discovery of the Martian moons as given by him in a letter to a friend in England. The following selections are from Hall's own words, preserved in the *Monthly Notices* of the Royal Astronomical Society, Vol. 38, 1877-8:

"The question whether Mars had a satellite or not, although at times occurring to me, I did not seriously consider until the spring of 1877. At that time several things had happened that brought this question prominently before me. Perhaps the principal of these was the discovery, in December 1876, of a white spot on the ball of Saturn, which gave me the means of determining the time of rotation of that planet, and taught me how untrustworthy may be the statements of the text books: this had made me ready to doubt the phrase one reads so often, 'Mars has no Moon.' Again, the favourable opposition of Mars in 1877 naturally attracted my attention. I then set to work to see what had been done in searching for satellites of this planet.

"Beginning with the observations of Sir William Herschel in 1783, I found, of course, a great mass of observations of the planet; but since the time of Herschel, who appears to have looked for satellites of Mars, no serious search had been made, except by one astronomer—Professor D'Arrest, of Copenhagen [with a 10-inch refractor] . . . . As D'Arrest was an accomplished astronomer and a skilful observer, the fact that he had found no moon on such a favourable occasion as the opposition of Mars in 1862 was discouraging; but, remembering the power and excellence of our glass, there seemed to be a little hope left. The southern declination of the planet in the opposition of 1877 was, however, against us, and the chances seemed to be in favour of the powerful reflector at Melbourne.

"The search was begun early in August, as soon as the geocentric motion of the planet made the detection of a satellite easy. At first my attention was directed to faint objects at some distance from Mars; but all these proving to be fixed stars, I began to examine the region close to the planet, and within the glare of light that surrounded it. This was done by keeping the planet just outside the field of view, and turning the eye-piece so as to pass completely around the planet. While making this examination on the night of August 11, I found a faint object on the following side and a little north of the planet, but had barely time to secure an observation of its position when fog from the Potomac River stopped the work. Cloudy weather intervened for several days.

"The search was resumed on August 15; but a thunderstorm in the early part of the night had put the atmosphere in a very bad condition, and Mars was so

blazing and unsteady that nothing could be seen of the object, which we now know was at that time so near the planet as to be invisible. On August 16 the object was found again on the following side of the planet, and the observation of that night showed that it was moving with the planet.

"On August 17, while waiting and watching for the outer satellite, the inner one was discovered. The observations made on the 17th and 18th put beyond doubt the character of these objects, and their discovery was publicly announced by Admiral [John] Rodgers [then superintendent of the Naval Observatory] on the 18th. For several days the inner moon was a puzzle. It would appear on different sides of the planet in the same night, and at first I thought there were two or three inner moons, since it seemed very improbable to me, at that time, that a satellite should revolve around its primary in less time than that in which the primary rotates. To settle this point I watched this moon throughout the nights of August 20 and 21, and saw that there was, in fact, but one inner moon, which made its revolution around the primary in less than one-third the time of the primary's rotation, a case unique in our solar system."

Hall observed the Martian satellites until October 31st, and the Washington observations by themselves gave sufficient data for accurate determinations of the orbits.[3] Henry Pritchett, at Glasgow, Missouri, made a "fine series of observations of both these faint moons" with a $12\frac{1}{4}$-inch Clark refractor. The outer satellite was seen at several observatories in Europe, but Hall stated that to his knowledge the inner and brighter one, more difficult to detect on account of its proximity to the planet, had not been observed abroad.

Newspaper editors of that day were quite impressed by the discovery. In a lead editorial on August 27, 1877, the Washington *Evening Star* declared: ". . . to the scientist the discovery is one of great interest and importance, more than compensating for the cost of the great equatorial telescope which brought the two satellites within human vision."

Along with news stories about Sitting Bull and the Indian fighting in the western states, one local story reported that the great number of people drawn to the Naval Observatory since the discovery of the moons had made it necessary to set up a system of issuing passes for all visitors.

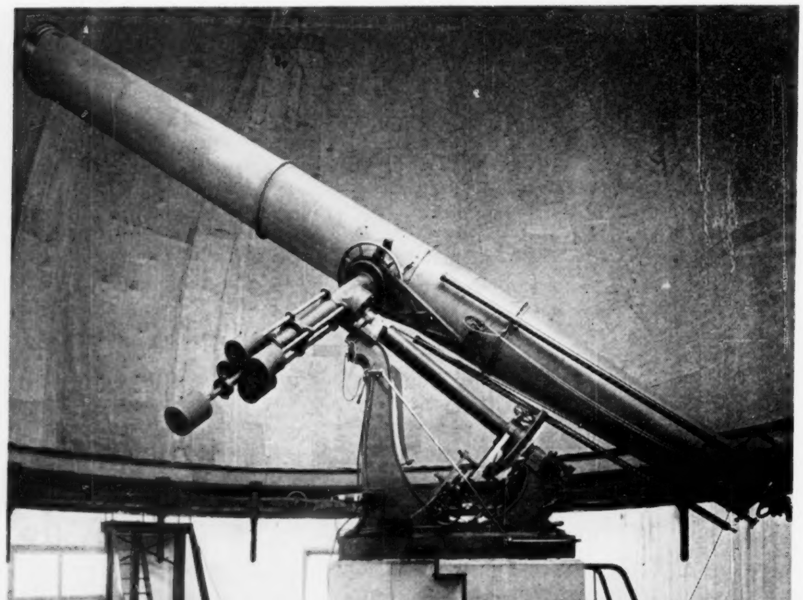
In another editorial in the fall of 1877, the *Evening Star* devoted several paragraphs to correcting an erroneous report that the Martian moons could be seen by simply watching the reflection of the planet in an ordinary mirror.

Hall's findings agree closely with the modern data: The inner satellite revolves some 5,800 miles from the center of the planet, so its average distance from Mars' surface is only about 3,700 miles. Its period of revolution is 7 hours, 39 minutes, while the planet takes $24^h\ 37^m\ 23^s$ to rotate once. Therefore, to an observer on Mars, this moon would appear to rise in the west and set in the east.

The outer satellite has a period of 30 hours, 18 minutes, at some 14,600 miles from the center of Mars. It is about one third as bright as the inner moon. Asaph Hall, in his letter, discusses size and brightness of the two newly discovered bodies.

"At the Harvard College Observatory, besides the observations for position made by Mr. L. Waldo, Professor Pickering and his assistants, Messrs. Searle and Upton, made an elaborate series of photometric measures of the brightness of these moons. From the results of these measures Professor Pickering infers that the diameter of the outer satellite is six miles, and the diameter of the inner satellite is seven miles. How nearly correct these values are it is hard to say. Both moons are always inside the glare of light that surrounds the planet, and perhaps the best way of determining their apparent magnitudes is that proposed by Mr. Wentworth Erck, of England, viz. to compare the satellite with a star which is at the same distance from the planet, and then, when the planet has moved away, to determine the magnitude of the star. But there remains the uncertainty of passing from a photometric measure of magnitude to the diameter of the reflecting body. Hence it seems probable that a considerable degree of uncertainty will remain concerning the real size of these satellites."

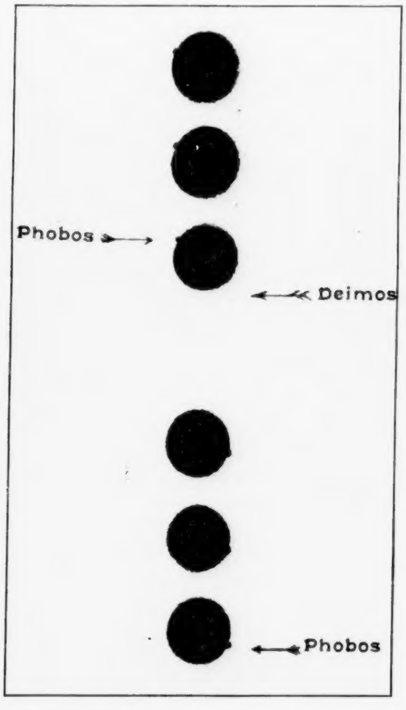
He goes on to describe how the satellites were seen remarkably bright in the 26-inch, both "measured with ease with Mars in the field of view," on the night of August 28th, the finest at Washington during that opposition. In the 9.6-inch Naval Observatory refractor, Professor Eastman observed the outer moon on August 21st and again on the 28th; it was faint but distinctly seen. On October 1st, also with this instrument, H. M. Paul could see the outer satellite with Mars



The Naval Observatory's 26-inch Clark refractor as Hall knew it. Erected in 1873 and since remounted, it has been used for eight decades of systematic satellite observations. From the "Washington Observations" for 1874.

in the field of view, using a magnification of 430. Hall states, "Both satellites were seen at several places in this country with Clark telescopes of 12 inches aperture; and in England the outer satellite was seen with a 7-inch Clark glass by Mr. W. Erck.

"If we adopt Argelander's scale of magnitudes, the smallest star visible in a 9.6-inch refractor is 14.1, and in the 7-inch glass 13.4. Allowing therefore for the glare of light around Mars, I think that at opposition we may assume that the outer satellite at its elongation was of the 12th magnitude. The inner satellite must be essentially brighter than the outer one, since I was able to observe it when it was less than 8″ distance from the limb of the planet; while I could not observe the outer satellite at a distance of less than 25″. Assuming the outer



The satellites of Mars are seen in these photographs of September 16-17, 1909, taken by S. Kostinsky with Poulkovo Observatory's 13-inch refractor. From top to bottom, the exposures were made at 10:23, 10:37, 10:51 p.m., and 1:56, 2:09, 2:23 a.m., Poulkovo time. In the first group of three, Phobos is near eastern elongation, which it reached at 10:34; then it quickly passed to western elongation at 2:23, where it is seen in the second group. Meanwhile, Deimos, approaching Mars from the west, became lost by midnight in the very much overexposed image of the planet. The exposure times necessary to show the faint satellites averaged 12 minutes. In 1896, with the same instrument, Kostinsky had secured the first successful photographs of these difficult objects. Reproduced from the "Bulletin" of the Poulkovo Observatory.

satellite to have a diameter of six miles, the angle subtended by this diameter on September 26, the date of Mr. Erck's last observation, was 0″.032; and on the date of Mr. Paul's observation this angle was 0″.031."

Finally, concerning the names of these companions of Mars, the mythological attendants of the god of war, Panic and Fear, seemed quite suitable to the satellite's discoverer, who concludes, "Of the various names that have been proposed for these satellites I like best those suggested from Homer by Mr. Madan, of Eton, viz. Deimos for the outer satellite, and Phobos for the inner one."

Amateur Astronomers

MID-STATES CONVENTION

The Central Missouri Amateur Astronomers were hosts to the seventh annual convention of the Mid-States Region of the Astronomical League, June 15-17, at Fayette, Mo. Eighty members and visitors represented clubs in Arkansas, Kansas, Illinois, Missouri, and Oklahoma.

Rainy weather greeted the gathering in Morrison Observatory, Central College, on opening day, but a break in the clouds by evening allowed good viewing through several telescopes, including the observatory's 12¼-inch Clark refractor.

The next day, a program of scientific papers was presented under the supervision of the St. Louis Astronomical Society, and a discussion was held on how to encourage junior amateurs and further their interest in astronomy.

The main address was given at the convention banquet Saturday evening, June 16th, by Dr. Keith Pierce, of McMath-Hulbert Observatory, University of Michigan, on "The Artificial Satellite, the Sun and the Geophysical Year." About 1:15 a.m. Sunday, we used three reflectors and five refractors to view Mars through a hazy sky.

Officers elected for the coming year were Miss Helen Edwards, Kansas City, Mo., chairman; C. P. Kulp, Little Rock, Ark., vice-chairman; Miss Jo Williamson, Fayette, Mo., secretary-treasurer; and Stuart O'Byrne, St. Louis, Mo., national representative.

JO WILLIAMSON
344 Howard Payne
Central College, Fayette, Mo.

LIMA, OHIO

Founded last year, the Lima Astronomy Club was reorganized at its June meeting with the writer as president; Ralph E. Krouskop, treasurer; Gene Swallows, recording secretary; and Mrs. Virginia Kampf, corresponding secretary.

We meet on the third Thursday of the month with intervening gatherings on special notice. This summer we have had public star parties at the city park, where the turnouts have been beyond expectation. On cloudy nights we showed films instead.

Further information about our group, which is open to all interested parties, may be had from the writer.

DAVID J. WOLF
1021 W. Market St., Lima, Ohio

THIS MONTH'S MEETINGS

Chicago, Ill.: Chicago Astronomical Society, 8 p.m., Adler Planetarium. Sept. 14, John Sternig, "The Earth Satellite Program."

Long Beach, Calif.: Excelsior Telescope Club, 7:30 p.m., home of Tom Cave, Sr., 265 Roswell Ave. Sept. 14, Tom Cave, Jr., "Mars—What Else?"

Omaha, Nebr.: Great Plains Astronomical Society, 2:15 p.m., Joslyn Art Museum. Sept. 16, general convention, "Satellite Tracking Problems."

Washington, D. C.: National Capital Astronomers, 8:15 p.m., Commerce Department auditorium. Sept. 8, Commander Charles Snay, U. S. Navy, "Operation Deepfreeze—IGY in the Antarctic."

Whittier, Calif.: Whittier Amateur Astronomers Association, 7:30 p.m., Bailey School building. Sept. 4, Charles Hagar, Griffith Observatory, "Radio Astronomy."

AUGUSTA, ARK.

On May 24th the Augusta Astronomy Club celebrated its second anniversary with a program we called "Astro-Rama." It attracted 50 interested persons, which we consider a rather good attendance since our population is only about 2,500.

We had exhibits in the local high school, prepared by various members on many astronomical subjects, and later we gave a program in the auditorium. An observing session had been publicized, but cloudy weather hindered our plans. Instead we held a demonstration of the Spitz, Jr. planetarium.

JOHN HARALSON
Box 296, Augusta, Ark.

MUSEUM PLANETARIUM WORKERS MEET

The planetarium section of the American Association of Museums held its sixth annual meeting in Cincinnati, Ohio, on May 30th. Representatives were present from about 35 planetariums and from various fields of museum work connected with astronomical exhibitions and programs.

Raymond J. Stein, chairman of the section, stated that reports from 25 of 46 museum planetariums in the United States showed their exhibit and lecture programs included such modern de-

velopments as solar power, artificial satellites, and rocket research.

Mrs. Maxine Begin Haarstick, curator of education, Science Museum, Minneapolis, Minn., was elected chairman for 1957.

Next year's meeting will be held in Lincoln, Nebr.

FREEHOLD, N. J.

Teen-agers in Freehold and the central New Jersey area interested in forming an amateur society, either by corresponding or meetings, are invited to contact Leonard Ellenbein, R.F.D. 1, Randolph Rd., Freehold, N. J., phone FR 8-1620. Beginners are welcome, whether they own telescopes or not.

TELEVISION SERIES BY BIRMINGHAM AMATEURS

The Shades Valley Astronomy Club, of Birmingham, Alabama, whose members' ages range from 7 to 70, has undertaken the ambitious project of presenting 15 weekly half-hour television programs this summer on channel 10 in Birmingham and Mumford, Ala.

The series is titled, "The Space Beyond," and its moderator is Pearce Graves, the society president. A feature of the program is the sky map of the week, with which members present varied topics of astronomical interest. Telecast on Alabama's educational network, the series began in June and was scheduled to extend until September.

The club, organized two years ago, has been active in other group projects such as building its own telescope, taking field

Here and There with Amateurs

*Members receive *Sky and Telescope* as a privilege of membership. †Member organizations of the Astronomical League.

State	City	Organization	Time	Meeting Place	Communicate With
ALABAMA	Birmingham	*Shades Valley A.C.	7:30, 3rd Tue.	Homewood Pub. Libr.	Mrs. Irven M. Cox, 208 Dexter Ave. (9)
ARIZONA	Phoenix	*Phoenix Obs. Ass'n	8:00, 2nd, 4th Mon.	Phoenix Coll., homes	A. H. Hoff, 1102 W. Thomas Rd.
	Tucson	*Tucson A.A.	7:30, 1st Wed.	Steward Obs.	Mrs. Kathryn Burch, 216 Busch Pl.
ARKANSAS	Augusta	†*Augusta A.C.	7:30, Fri.	Private homes	J. W. Haralson, Box 296
	Little Rock	†*Arkansas A.A.C.	7:30, 3rd Mon.	Various places	C. P. Kulp, 1322 Donaghey Bldg.
CALIFORNIA	Bakersfield	Bakersfield A.A.	7:30, 1st Thu.	7-Up Bldg.	J. O. Davis, 400 S. Hill St., Arvin
	Bakersfield	†*Kern A.S.	7:30, Alt. Sun.	Youth Building	Brian Buchholz, 2609 Charleston Dr.
	Fresno	*Central Val. Ast'mers	7:45, 2nd Mon.	Fresno Coll., homes	Elizabeth Dean, 3534 N. Callisch (3)
	Kentfield	*Marin Am. Ast.	8:00, 1st Mon.	Coll. of Marin	Rita Treleven, Box 102, Fairfax
	Long Beach	†*Excelsior Tel. Club	7:30, 3rd Fri.	Private homes	T. R. Cave, Jr., 265 Roswell Ave. (3)
	Los Angeles	L.A.A.S.	7:45, 2nd Tue.	Griffith Obs.	Miss H. Pearce, 1000 N. Seward, H'wood (38)
	Oakland	*Eastbay A.S.	8:00, 1st Sat.	Chabot Obs.	F. O. Groch, 2315 Eunice St., Berkeley (8)
	Oroville	Feather River A.C.	8:00, 2nd, 4th Tue.	Private homes	John T. Jensen, Rt. 4, Box 1732
	Palo Alto	*Peninsula A.S.	8:00, 1st Fri.	Community Center	A. Badenhop, Jr. Mus., 1305 Middlefield Rd.
	Redlands	*Redlands A.S.	8:00, 4th Thu.	Univ. of Redlands	Miss R. Schweikert, 111 Prospect Dr.
	Sacramento	*Sac. Val. A.S.	8:00, 2nd Thu.	Calif. Jr. Mus.	Mrs. H. N. Smith, 1608 48th St. (19)
	Santa Barbara	S. B. Star Cluster	8:00, Last Tue.	Private homes	Capt. C. Adair, 607 Miramonte Dr.
	San Diego	Ast. Soc. of S.D.	7:30, 1st Wed.	504 Electric Bldg.	W. T. Skilling, 3140 Sixth Ave.
	San Diego	A.T.M. Ast. Club	7:30, 2nd, 4th Mon.	3121 Hawthorn St.	Al Nelson, 3121 Hawthorn St.
	San Francisco	*S.F. Am. Ast'mers	8:00, 1st Wed.	Randall Jr. Museum	H. A. Wallace, 2925-A Jackson St.
	San Jose	*S. J. Am. Ast'mers	8:00, 3rd Mon.	State Coll., Sci. Wing	T. J. Nelson, Jr., 822 W. Iowa, Sunnyvale
	Stockton	*Stockton A.S.	8:00, 2nd Mon.	Stockton Coll., C-3	W. D. Purdy, 325 E. Kettleman Lane, Lodi
	Whittier	†*Whittier A.A.A.	7:30, 1st Tue.	Bailey School	Gary A. McCue, P.O. Box 531
	Whittier	†*Whittier A.S.	7:00, Alt. Sun.	Private homes	R. N. Sturtridge, 8416 Davista Dr.
COLORADO	Boulder	*Boulder A.S.	7:30, 2nd Wed.	Sommers-Bausch Obs.	Vernon Goerke, 3045 Bluff St., HI 2-3447
	Denver	*Denver A.S.	8:00, 2nd, 4th Fri.	Chamberlin Obs.	R. A. Spencer, 1711 Washington Ave., Golden
	Pueblo	†*Pueblo A.S.	7:30, 1st Mon.	2421 2nd Ave.	Mrs. Marjorie Struthers, 2329 E. Routt Ave.
CONNECTICUT	Groton	*Thames A.A.S.	8:00, 2nd Wed.	Private homes	R. Steinhilber, 245 Willetts Ave., New London
	Middletown	†*Central Conn. A.A.	8:00, 1st Tue.	Van Vleck Obs.	W. Fellows, RFD No. 1, Hill St., Glastonbury
	New Haven	†A.S. of New Haven	8:00, 4th Sat.	Sterling Tower	Florence Welter, 77 Spring Rd., N'th Haven
	Stamford	†Fairfield Co. A.S.	8:30, 3rd Fri.	Stamford Museum	Mrs. R. Best, Stamford Museum
	Stratford	†*Boothe Mem. A.S.	8:30, 4th Tue.	Boothe Mem. Park	A. Farian, 227 Spring, Bridgeport (8)
DIST. COL.	Washington	†*Nat'l. Cap. Ast'mers	8:00, 1st Sat.	Comm. Dept. Audit.	Elsa Dimick, 1305 Longfellow, Arlington, Va.
FLORIDA	Daytona Beach	D. B. Stargazers	8:00, Alt. Mon.	105 N. Halifax Ave.	Wm. T. Thomas, 105 N. Halifax
	Eau Gallie	†*Indian River A.S.	8:00, 2nd Wed.	City Hall	Mrs. Helen DePaolo, 1353 Everglade Dr.
	Jacksonville	†*J.A.A.C.	8:30, 1st, 3rd Mon.	Private homes	E. L. Rowland, Jr., 225 W. Ashley St. (2)
	Key West	†*Key West A.C.	7:30, 2nd Mon.	Private homes	J. M. Martin, 1521 Duncan St.
	Miami	†*South'n Cross A.S.	8:15, 3rd Mon.	Junior Museum	A. P. Smith, Jr., 426 S. W. 26 Rd. (36)
	Miami Springs	†*Gulfstream A.A.	8:00, 4th Wed.	University of Miami	L. G. Pardue, 641 Falcon, TU 8-5434
	Orlando	*A.A.C. of Orlando	7:30, 2nd Thu.	Edgewater H.S.	Claude B. Green, 354 Mashie Lane
	Pensacola	†Pensacola A.A.C.	8:00, Wed.	Private homes	John Aguilar, 1203 N. 9 Ave.
	St. Petersburg	†St. P'burg A.A.C.	7:30, 4th Tue.	City Museum Audit.	Dr. R. E. Angell, 233 5th Ave. N.
GEORGIA	Atlanta	†*Atlanta A.C.	8:00, 3rd Fri.	Agnes Scott College	W. H. Close, 225 Forkner Dr., Decatur
	Macon	†*Macon A.A.C.	8:00, Alt. Thu.	Rt. 1, Riverside Dr.	Harvey W. Healey, 413 Rogers Ave.
HAWAII	Honolulu	Hawaii A.S.	7:30, 3rd Tue.	McKinley H.S., Cot. 36	R. Terry, 99-531 Kaholi Pl., Aiea, 463762
IDAHO	Idaho Falls	Idaho A.A.	8:00, 1st Sat.	475 J St.	Mrs. O. W. Hendrickson, 475 J St.
ILLINOIS	Chicago	†*Chicago A.S.	3:00, 2nd Sun.	Adler Planetarium	J. A. Anderer, 7929 S. Loomis Blvd. (20)
	Galesburg	†*G'burg Am. Ast'mers	7:30, 1st Wed.	Knox Obs.	H. L. Horein, 1246 N. Morton Ave.
	Geneva	*Fox Valley A.S.	8:00, 2nd Tue.	Geneva City Hall	Joseph Zoda, 420 Fellows St., St. Charles
	Lombard	†*Tree Towns A.C.	7:30, Various days	26 S. Westmore	Larry Ewing, 26 S. Westmore
	Moline	†*Popular A.C.	7:30, Wed.	Sky Ridge Obs.	Carl H. Gamble, 3201 Coaltown Rd.
	Peoria	Ast. Sec., Acad. Sci.	8:00, 1st Wed.	Glen Oak Pk. Pav'n.	R. P. Van Zandt, 156 N. Eleanor Pl. (5)
INDIANA	Indianapolis	†*Indiana A.S.	2:15, 1st Sun.	Riley Library	W. E. Wilkins, 6124 Dewey Ave. (19), IR-5946
IOWA	Des Moines	Ia. Div., Gt. Pl. A.S.	2:00, 3rd Sun.	Drake Obs.	Dale Cruikshank, 3655 67th St. (10)
KANSAS	Wichita	†*Wichita A.S.	8:00, 1st Wed.	Friends Univ.	S. S. Whitehead, 425 N. Lorraine (8), 62-6642
KENTUCKY	Louisville	†L'ville A.S.	8:00, 1st Tue.	Univ. of Louisville	B. F. Kubaugh, 207 Sage Rd. (7)
	Louisville	†*L'ville Jr. A.S.	7:30, 3rd Tue.	Private homes	Carol Lipphard, 2421 Calvin Ave. (6)
LOUISIANA	Gretna	Gretna A.S.	7:00, 2nd, 4th Sat.	209 Newton St.	John A. Gunther, 209 Newton St., FO 1-0034
	Lake Charles	†*Lake Charles A.A.C.	7:45, 2nd Tue.	H.S. Chem. Lab.	C. Fronczek, Rt. 1, Box 51, Westlake
	New Orleans	A.S. of N.O.	Irregular	Cunningham Obs.	Dr. J. Adair Lyon, 1210 Broadway
	New Orleans	N.O.A.A.A.	7:30, 2nd, 4th Sat.	DeLaSalle H.S.	Wm. E. Wulf, 2107 Annunciation St. (13)
MARYLAND	Baltimore	Baltimore A.S.	8:00, 3rd Mon.	Pratt Libr. Audit.	Mrs. G. Stolberg, 6020 Cross Country Blvd. (15)
MASSACHUSETTS	Cambridge	†*Bond A.C.	8:00, 1st Thu.	Harvard Obs.	R. Smith, 519 Quincy Shore Dr., No. Quincy 71
	Cambridge	†*A.T.M.s of Boston	8:00, 2nd Thu.	Harvard Obs.	W. Knight, 75 S. Crescent Cir., Brighton 35
	Springfield	†*S'field Stars	8:00, 2nd Wed.	Private homes	J. Welch, 107 Low'r B'verly Hills, W. S'field
	Worcester	†*Aldrich A.S.	7:30, 1st, 3rd Tue.	Mus. Natural Hist.	W. C. Lovell, 24 Courtland (2), 3-1559
MICHIGAN	Battle Creek	†B. C. A.A.C.	8:00, 2nd Fri.	Kingman Museum	Mrs. W. V. Eichenlaub, 47 Everett Ave.
	Detroit	†*Detroit A.S.	2:30, 2nd Sun.	Wayne U., State Hall	E. R. Phelps, Wayne University
	Grand Rapids	Grand Rapids A.A.A.	8:00, 3rd Fri.	Public Museum	J. C. Veen, Sr., 2100 Francis Ave. S. E. (7)
	Jackson	*Jackson A.S.	7:30, 2nd Thu.	Public Library	Allen Bell, 1103 Hamlin Pl.
	Kalamazoo	†Kalamazoo A.A.A.	8:00, Sat.	Private homes	Edgar Pashby, 420 Evelyn Ave.
	Lansing	†*Lansing A.A.	8:00, Sat.	Private homes	R. Elliott, 434 Cowley Ave., E. Lansing
	Pontiac	†*Pon.-N.W. Det. A.A.	7:30, 3rd Thu.	Lincoln Jr. H.S.	G. Carhart, 40 Hadsell Dr., FE 2-9980
MINNESOTA	Minneapolis	*J.A.C. of M'polis	4:15, 2nd, 4th Wed.	Public Library	E. Haskins, 3732 Garfield Ave. S., RE-0201
	Minneapolis	†M'polis A.C.	Irregular	Public Library	Mrs. M. Haarstick, Sci. Mus., M'polis Pub. Lib.
	St. Paul	†*St. Paul Tel. Club	7:30, 2nd, 4th Wed.	Macalester Coll.	Mrs. R. E. English, 1283 Sargent Ave. (5)
MISSOURI	Fayette	†*Central Mo. A.A.	7:30, 3rd Sat.	Morrison Obs.	R. C. Maag, 816¼ S. Mass., Sedalia
	Kansas City	†*A.C. of Kans. City	8:00, 4th Sat.	K.C. Museum	Mrs. Laura Kinsey, 4604 Jefferson (12)
	St. Louis	†*St. Louis A.A.S.	8:00, 3rd Fri.	Inst. of Tech., St. L. U.	Mrs. N. Fallert, 1509 N. Berry Rd., Rock Hill (19)

trips, serving as consultant to an elementary school astronomy class, and assisting a troop of teen-age explorer scouts in earning merit badges in astronomy.

MRS. IRVEN M. COX
208 Dexter Ave.
Birmingham 9, Ala.

HAYDEN PLANETARIUM CLASSES

A navigation course for small-boat owners will be offered for the first time this fall in the American Museum-Hayden Planetarium's program of adult classes in astronomy, navigation, and meteorology.

"Navigation in Coastal Waters" will be given on Friday evenings beginning October 5th. It will provide an introduction to navigation in confined waters with emphasis on charts, compasses, other aids to navigation, and methods of safe piloting. No previous study or experience is required. In January an advanced course will be offered.

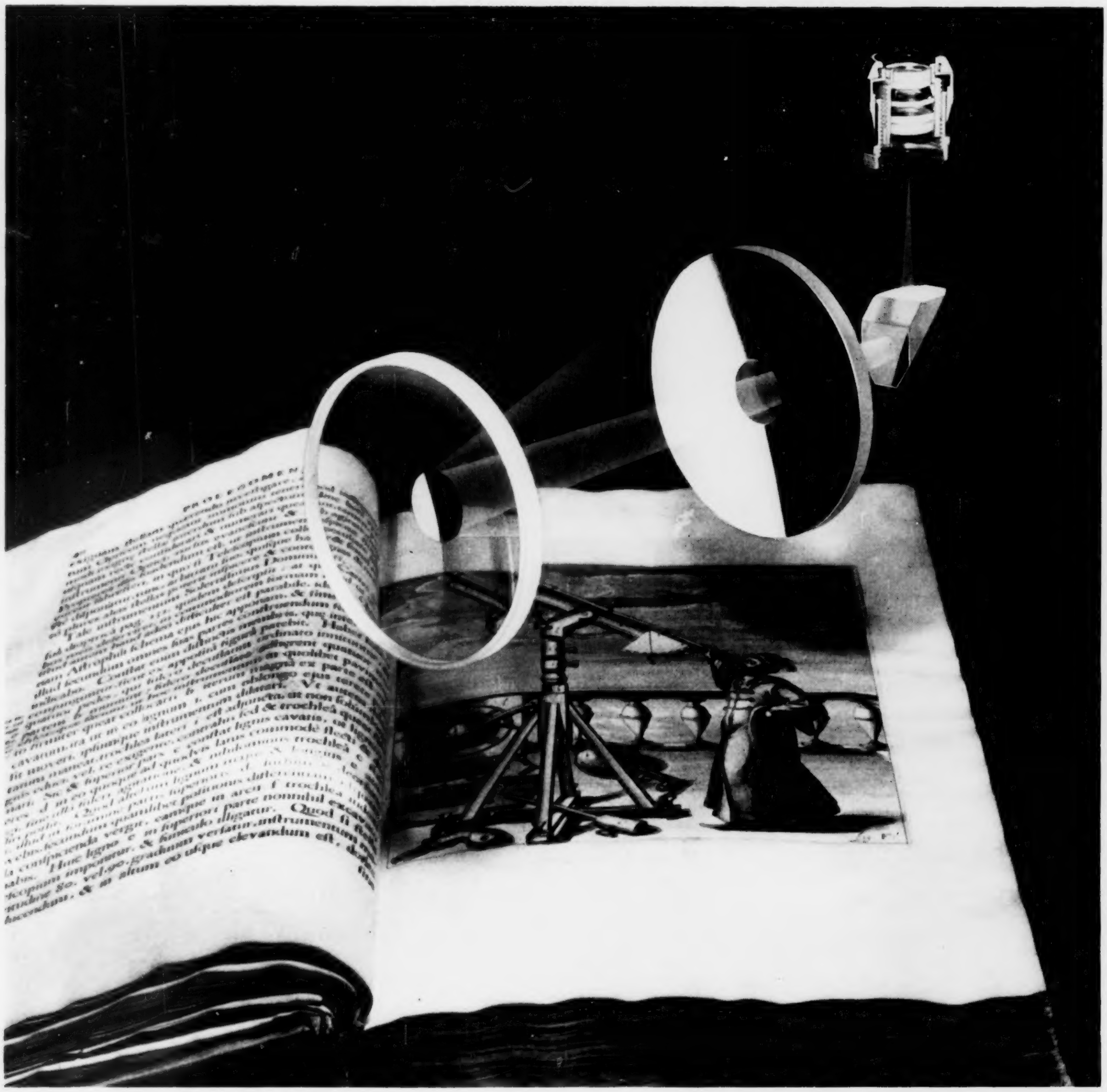
Companion courses in the fall schedule include "Introduction to Celestial Navigation," designed both for beginners and as a refresher course, "Introduction to Meteorology," and "Star Identification."

The planetarium's round table series on descriptive astronomy includes introductory and intermediate classes. "Astronomy for the Family," intended especially for young people and their parents, will be presented on Saturday mornings.

A course catalogue may be obtained from the American Museum-Hayden Planetarium, New York 24, N. Y., or by telephoning TRafalgar 3-1300, extension 363.

HERE AND THERE WITH AMATEURS *(continued)*

State	City	Organization	Time	Meeting Place	Communicate With
MONTANA	Helena	A.A.C. of Helena	7:00, 3rd Wed.	Private homes	Dr. T. J. Mentrum, 328 N. Benton Ave.
NEBRASKA	Omaha	Omaha Div., Gt. Pl. A.S.	2:15, 3rd Sun.	Private homes	Robert Osborne, 2709 N 56 St.
NEVADA	Reno	A.S. of Nevada	8:00, 4th Thu.	Univ. of Nevada	Dr. Vernon Frazier, University of Nevada
NEW HAMPSHIRE	Newmarket	*Gr't Bay Am. Ast'mers	7:30, Alt. Tue.	Public Library	A. R. Brackett, 72 Gov't. St., Kittery, Me.
NEW JERSEY	Caldwell	West Essex A.S.	8:30, 2nd Mon.	Caldwell Mun. Bldg.	Donald C. Smith, 19 Francisco Ave.
	Rutherford	A.S. of Rutherford	8:00, 1st Thu.	YMCA	Mrs. Helen Waite, 11 Bryan Ct.
	Springfield	†*A.A.S. of Union Co.	8:00, 4th Fri.	Regional H. S.	W. A. Munn, 220 E. Westfield Ave., Roselle Pk.
	Teaneck	†Bergen Co. A.S.	8:30, 2nd Wed.	Obs., H.S. grounds	Eva Goldenberg, 628 S. Forest Dr., W. Englewood
NEW MEXICO	Las Cruces	†*A.S. of L.C.	7:30, 1st or 2nd Sat.	Private homes	W. H. Haas, 1203 N. Alameda Blvd.
	Roswell	*Pecos Val. S.&T.C.	7:30, 2nd Fri.	Cham. of Comm.	Dr. R. R. Boice, Rt. 2, Box 163A
NEW YORK	Binghamton	A.S. of Broome Co.	7:30, 2nd Tue.	Roberson Mem. Ctr.	Mrs. J. W. Sullivan, 11 Brookfield Rd.
	Brooklyn	†Junior A.C.	8:00, 3rd Fri.	B'klyn Public Library	Jr. A. C., Pub. Lib., Grand Army Plaza (38)
	Buffalo	†*Buffalo A.A.	7:30, 1st Wed.	Mus. of Science	W. Semerau, 135 Zimmerman Blvd. (17)
	Corning	Corning A.C.	8:00, 1st, 3rd Mon.	Corning Glass Center	W. R. Redmond, 3 E. 3rd St.
	Gloversville	†A.C. of Fulton Co.	6:30, Wed.	Private homes	Emmanuel Weil, 38 E. Blvd.
	Hicksville	L.I. Obs. Ass'n	8:00, Wed.	369 Staples, F'dale	J. Tosto, 369 Staples, Farmingdale
	New York	*A.A.A.	8:00, 1st Wed.	Amer. Mus. Nat. Hist.	G. V. Plachy, 201 W. 79th (24), EN 2-7100
	Rochester	†Ast. Sec., Acad. Sci.	8:00, 1st Fri.	Rochester Museum	Margaret Frisch, 38 Harris St. (21)
	Schenectady	†*S'tady A.C.	7:30, 3rd Mon.	Union Coll., C.E. Bldg.	C. E. Johnson, 102 State St.
	Syracuse	†*Syracuse A.S.	8:00, 4th Thu.	Syr. U., 206 Steele	A. E. Krawcek, 305 Pleasant Ave., N. Syr.
	Troy	†*Renss. Ap. Soc.	8:00, Fri.	R.P.I. Obs.	Dr. Robert Fleischer, R.P.I.
	Troy	†*Troy A.C.	8:00, 4th Sat.	Private homes	John Watkins, Valley Falls
	Utica	†*Utica Am. Ast'mers	7:30, 4th Tue.	Proctor Inst.	S. Wolczanski, 506 William St.
	Wantagh	Long Island A.S.	8:00, Sat.	Private homes	A. R. Luechinger, 2009 Seaford Ave., 1571
N. CAROLINA	Chapel Hill	†*Chapel Hill A.C.	8:00, Alt. Wed.	Morehead Plan.	C. C. Tucker, Jr., Morehead Planetarium
	Charlotte	†*Charlotte A.A.C.	8:00, Last Mon.	Myers Pk. H.S.	Mrs. L. W. Kelly, 1014 Kennilworth Ave. (3)
	Greensboro	†*Greensboro A.C.	8:00, Fri.	Woman's Coll., U.N.C.	Dr. A. D. Shaftesbury, 315 Tate St.
	Winston-Salem	†*Forsyth A.S.	7:30, Last Fri.	Private homes	Kenneth Shepherd, 903 W. End Blvd.
NORTH DAKOTA	Grand Forks	†*Red River A.C.	8:00, 2nd, 4th Mon.	City Hall	L. G. Peck, 2101 1st Ave. North
OHIO	Akron	*A.C. of Akron	8:00, Last Fri.	YMCA	Mrs. R. J. Couts, 878 Kennebec Ave. (5)
	Cincinnati	*Cin. A.A.	8:00, Various days	Cincinnati Obs.	James T. Mettey, 2914 Minot Ave. (9)
	Cincinnati	*Cin. A.S.	8:00, 3rd Fri.	Obs., Zion Rd., M. Hts.	Isolina Cartlidge, 5556 Raceview Ave. (11)
	Cleveland	Cleveland A.S.	8:00, Fri.	Warner & Swasey Obs.	Mrs. Helen Strohm, Warner & Swasey Obs.
	Columbus	*Battelle A.C.	Noon, Wed.	Battelle Mem. Inst.	William J. Stahl, Battelle Memorial Institute
	Columbus	†*Columbus A.S.	8:00, 2nd Sat.	McMillin Obs.	Mrs. Jane Gann, 420 N. Cassady Rd. (9)
	Dayton	Miami Valley A.S.	8:00, 2nd Fri.	Nat. Hist. Museum	F. E. Sutter, 5038 Lebanon Pike (9)
	Lorain-Elyria	*Black River A.S.	7:30, 3rd Sat.	Holly Hall	George Diedrich, 653 Weller Rd.
	Marietta	Marietta A.S.	Irregular	Cisler Terrace	Miss L. E. Cisler, Cisler Terrace
	Newark	Newark A.S.	7:30, 3rd Sat.	YMCA	Gene Cooperrider, 326 N. 11th St.
	Toledo	Toledo Ast. Club	...., 3rd Tue.	Univ. of Toledo Obs.	E. D. Edenburn, 4124 Commonwealth Ave.
	Warren	Mahoning Val. A.S.	8:00, Fri.	Private homes	C. R. Prather, 1363 Drexel, NW, 4494-2
	Youngstown	*Y'town A.C.	7:30, 1st Fri.	Homestead Pk. Pav'n.	F. W. Hartenstein, 907 Brentwood
OKLAHOMA	Tulsa	†*A.C. of Tulsa	7:30, 1st Sat.	Private homes	J. C. Wells, 524 S. 78th E. Ave.
OREGON	Portland	†*Portland A.S.	7:30, 1st Tue.	Central Public Lib.	Mrs. Marge Krutsinger, 6525 NE Davis St. (16)
	Portland	†A.T.M. & Observers	8:00, 2nd Tue.	Private homes	Mrs. Marge Krutsinger, 6525 NE Davis St. (16)
PENNSYLVANIA	Beaver	†*Beaver Co. A.A.A.	8:00, 2nd Tue.	Private homes	Mrs. R. T. LuCaric, Brownsdale Plan. Baden
	Harrisburg	†*A. S. of Harrisburg	8:00, 1st Mon.	State Museum	Edward J. Naylor, 320 Wilhelm Rd.
	Millvale	A.A.A. Shaler T'ship	8:00, 1st Fri.	Cherry City Fire House	Cliff Raible, 200 Rebecca Sq. (9)
	Philadelphia	†A.A. of F.I.	8:00, 3rd Fri.	Franklin Institute	Edwin F. Bailey, LO 4-3600
	Philadelphia	†*Rittenhouse A.S.	8:00, Fri.	Franklin Institute	John W. Streeter, LO 4-3600
	Pittsburgh	†*A.A.A. of P'burgh	8:00, 2nd Fri.	Buhl Planetarium	Mary Burcik, 315 Moore Ave. (10)
	Pottstown	†Pottstown A.A.C.	7:30, Fri.	Public Library	W. E. Schultz, Public Library
	Springdale	*Alleghany Val. A.A.A.	8:00, 1st, 3rd Fri.	Private homes	Wm. E. Stocks, 215 Carson St.
RHODE ISLAND	N. Scituate	Skyscrapers, Inc.	8:00, Mon. or Wed.	Seagrave Mem. Obs.	Seagrave Mem. Obs., Box 157
TENNESSEE	Chattanooga	†*Barnard A.S.	8:00, 3rd Fri.	Jones Observatory	A. H. Jones, 411 W. 21st St., 5-1646
	Memphis	†*Memphis A.S.	7:30, 2nd Sat.	Memphis Museum	Ned Lawrence, 3081 Chisca Ave.
	Nashville	*Barnard A.S.	8:00, 2nd Thu.	Dyer Observatory	Miss C. Kidd, Dyer Obs., Vanderbilt U.
	Portland	Portland A.S.	7:30, 1st, 3rd Sat.	Private homes	Robert O. Riggs, Box 42
TEXAS	Abilene	*Abilene A.S.	7:30, 4th Mon.	Phys. Rm., H.-S.U.	T. D. Roberts, Hardin-Simmons Univ.
	Austin	†*Forty Acres A.C.	7:30, 1st Tue.	U. of Tex., Physics Bldg.	Forty Acres A.C., Box 7994, Univ. Sta.
	Brownfield	*Brownfield A.C.	8:00, 3rd Wed.	Private homes	Charles W. Isbell, Brownfield 2074
	Dallas	†Texas A.S.	8:00, 4th Mon.	Various auditoriums	E. M. Brewer, 5218 Morningside, UN-3894
	Ft. Worth	†*Ft. Worth A.S.	8:00, 4th Thu.	Children's Museum	James M. McMillen, 604 Tierney Rd. (3)
	Houston	Houston A.A.C.	...., 1st Fri.	Nat. Hist. Museum	W. W. Myers, 7424 Tipps St. (23)
	Laredo	*Laredo A.C.	8:00, 2nd Tue.	Laredo Jr. Coll.	Sidney Freidin, Box 1148
	Port Arthur	†*Port Arthur A.C.	7:30, 2nd Thu.	5228 Fifth St.	F. T. Newton, 5213 Fifth St., 2-4807
UTAH	Salt Lake City	*A.S. of Utah	8:00, 2nd Thu.	City and County Bldg.	James W. Geertsen, 4461 S. 9th East St.
VIRGINIA	Harrisonburg	Astral Society	Monthly	Vesper Heights Obs.	M. T. Brackbill, Eastern Mennonite College
	Norfolk	†*Norfolk A.S.	8:00, 2nd Thu.	Museum of Arts	A. Hustead, U.S. Weather Bureau, LO 3-4368
	Richmond	†*Richmond A.S.	8:00, 1st Tue.	601 E. Franklin St.	B. S. Ragland, 601 E. Franklin St. (19)
	Roanoke	*Am. Ast'mers of Roa.	...., 3rd Fri.	Bank of Virginia	Robert Ayers, 828 Stewart Ave. SE, 4-9398
WASHINGTON	Seattle	†*Seattle A.A.S.	8:00, 2nd Wed.	Eagle'n Hall, 1417 E. 42	Norman Dalke, 3640 Densmore Ave.
	Spokane	†*A.T.M.s of Spokane	8:00, Last Fri.	Private homes	Sue Stockton, S. 2129 Grand Blvd.
	Tacoma	†Tacoma A.A.	8:00, 1st Mon.	Coll. of Puget Sd.	Mrs. Roy Atkinson, 2816 N. Union Ave.
	Yakima	†*Yak. Am. Ast'mers	8:00, 2nd Mon.	Cascade Creamery	Edward J. Newman, 324 W. Yakima Ave.
WEST VIRGINIA	Fairmont	†Fairmont A.A.A.	7:30, 2nd Fri.	State Coll., Sci. Hall	David Meisel, 800 8th St.
	Wheeling	Oglebay Ast. Ass'n	8:00, 1st, 3rd Thu.	Brooks Nature Center	R. Schramm, Speidel Obs., Oglebay Inst.
WISCONSIN	Beloit	†*Beloit A.S.	7:30, 2nd, 4th Wed.	YMCA Bldg.	K. E. Patterson, 318 Public Service Bldg.
	Madison	†Madison A.S.	8:00, 2nd Wed.	Washburn Obs.	Dr. C. M. Huffer, Washburn Obs.
	Milwaukee	†*Milw. A.S.	7:45, 3rd Fri.	Finney Branch Lib.	E. A. Halbach, 2971 S. 52 St. (15)
	Sheboygan	*Sheboygan A.S.	7:30, 2nd Tue.	Mead Public Lib.	Edward Parnitzke, Jr., Route 2



BREAK-THROUGH IN OPTICAL SCIENCE

In only 44 years the twenty-first century will be upon us. Many who read these lines will surely be around to celebrate the end of the second millenium and welcome the beginning of the third.

By that time, of course, there will be many new kinds of telescopes, for it seems unlikely that this prime tool of science will ever again go two hundred years without change, as it did from the eighteenth to the twentieth centuries.

We should imagine that many optical systems of the future will be of the new catadioptric, or mixed lens-and-mirror type, like the one pictured above, which is Questar's. The great discovery that a lens and mirror together could produce a whole new class of superior instruments, including the Schmidt camera, was the major break-through in optical science of our century.

Questar has employed the new principles to produce a Cassegrain system of extreme shortness. See for yourself how compact it is. Yet at 160 diameters this arrangement performs like a telescope 7 feet long!

Notice how small we have kept the little secondary spot mirror — a secret of ultimate sharpness in Cassegrain design. Observe, too, that it has no diffraction-causing metal supports, being carried by the lens that seals off the tube against drafts, dirt, corrosion and insect attack.

Only 6 inches behind the 89-mm. aperture lens is the primary mirror of 97-mm. diameter. This is the jewel of exquisite surface, the part that for 3 years defied manufacture. For its f/2 focal ratio is so brutally short that its surface must be accurate to no less than 1/64 wave length in order to work at all. This is 16 times finer than the ¼-wave mirrors that suffice for conventional f/8 reflectors used by many veteran observers.

Having mastered the making of these elements to the new order of hyper-precision required, Questar offers the same optics in two styles of mountings — the elegant De Luxe Questar with ingenious built-in accessories, which is the most patented telescope of record, and the 31-ounce Field Model.

The happy astronomer at his small-apertured refractor appears in our copy of John Hevel's (Hevelius') ***Selenographia***, published in 1647, just 38 years after Galileo developed the first practical telescope. The picturesque old boy above serves to remind us that refractors do not look much different after 309 years, and that the earliest observers were able men who well understood the value of massive, shakeproof mountings for their long spyglasses.

QUESTAR PRESENTS A FINE PORTABLE PRECISION TRIPOD

We have been up to our necks in tripods around here these past months, searching for one we could honestly recommend to those who use their Questars in the field. Our office has been full of them — good, fair and just plain wobbly. You'll have to forgive us if we are cranky and crotchety on this touchy subject of shaky tripods, for we've seldom seen one that couldn't use some sturdy bracing. We were looking, too, for one that was lightweight, had both spikes and rubber tips and would fold to some 3 feet, so you could tuck it easily into your car.

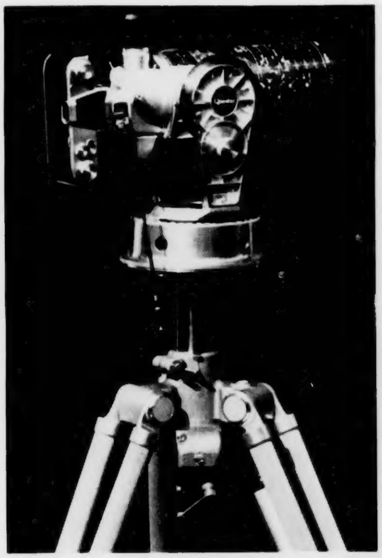
Our choice is the beautiful instrument pictured here, for which we have become distributors. It is made in Bavaria by Linhof of Munich, whose "Super-Technica" cameras have long been famous everywhere. Called the Professional De Luxe, this impressive stand looks weightier than its 17½ actual pounds. Built of aluminum alloys to carry 11 x 14 plate cameras and heavy motion picture cameras, perhaps its most excellent and rewarding feature is the geared elevating center post whose smooth light action will raise your 'scope exactly to your eye at a touch of the good-sized crank. This relieves you of constant leg adjustments to put an eyepiece at the precise height you wish it for every change of view.

You'll like the big captive rubber tips that screw down to render harmless the sharp steel spikes that otherwise would rip your floors at home, or car interior while traveling. This is a feature of real importance because people can get hurt by a tripod carried with bare spikes exposed.

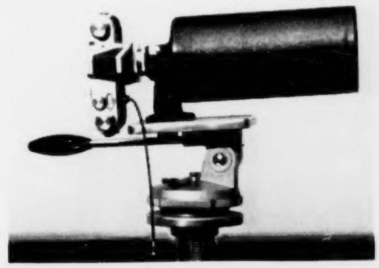
Each 34-inch leg extends to 60 inches, but fortunately you won't need to run them out that far for telescopic use. Beyond a foot or so extension, small tremors rapidly increase. (So now we've warned you, but then we're mighty fussy on this subject of vibration.)

The Linhof Professional De Luxe Pan Head matches the tripod and is of equal quality and workmanship. It moves with ease and smoothness and has index marks and clamps in altitude and azimuth. The leather-covered platform has slots for positioning the standard thread attaching thumbscrew. It will orient the Field Model Questar, or tilt the De Luxe Questar into polar equatorial position. We will soon have an inexpensive auxiliary base plate to attach the latter to both post and Pan Head.

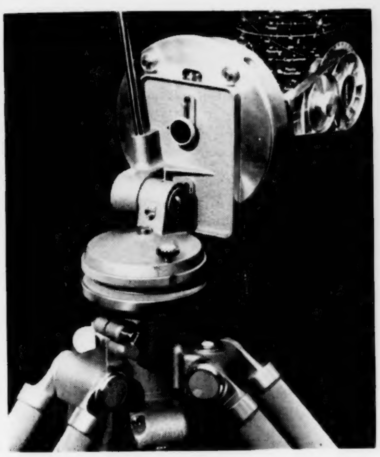
We hope this splendid tripod will please not only Questar owners, but many others who appreciate owning and using fine things. Available for immediate delivery. Shipment by express, f.o.b. New York, but not c.o.d., please. Tripod with geared center post, $169.50, Pan Head, $38.50.



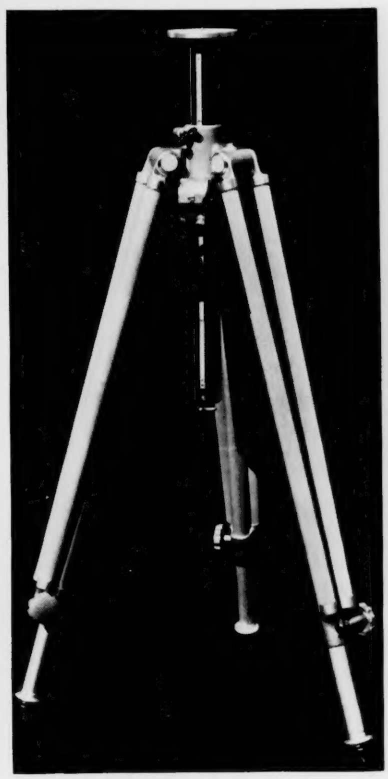
De Luxe Questar on 50-mm. dia. geared chrome center post. Note large, easy working handle, and clamp at casting top. Upper legs are covered with tough ribbed Cellon. Entire tripod beautifully finished in warm gray color, with chrome and leather trim.



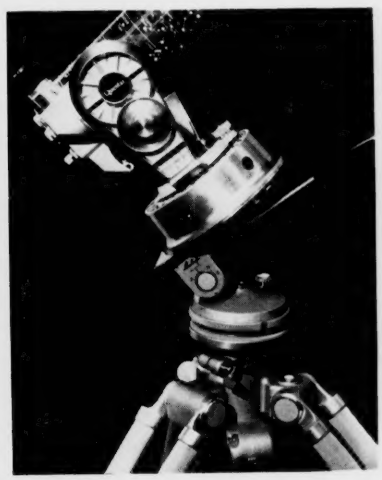
Precision Pan Head with Questar Field Model and penta-prism camera body. Turning the handle locks tilt, knob locks panoramic movement in azimuth. Weight 3 lbs.



Showing underside of 4¼ x 5⅞ Pan Head platform. Note two slots for U.S. standard ¼-20 thumbscrew. Auxiliary base plate holds Questar offset for electric plug-in. Note spirit levels at leg hinge and head center.



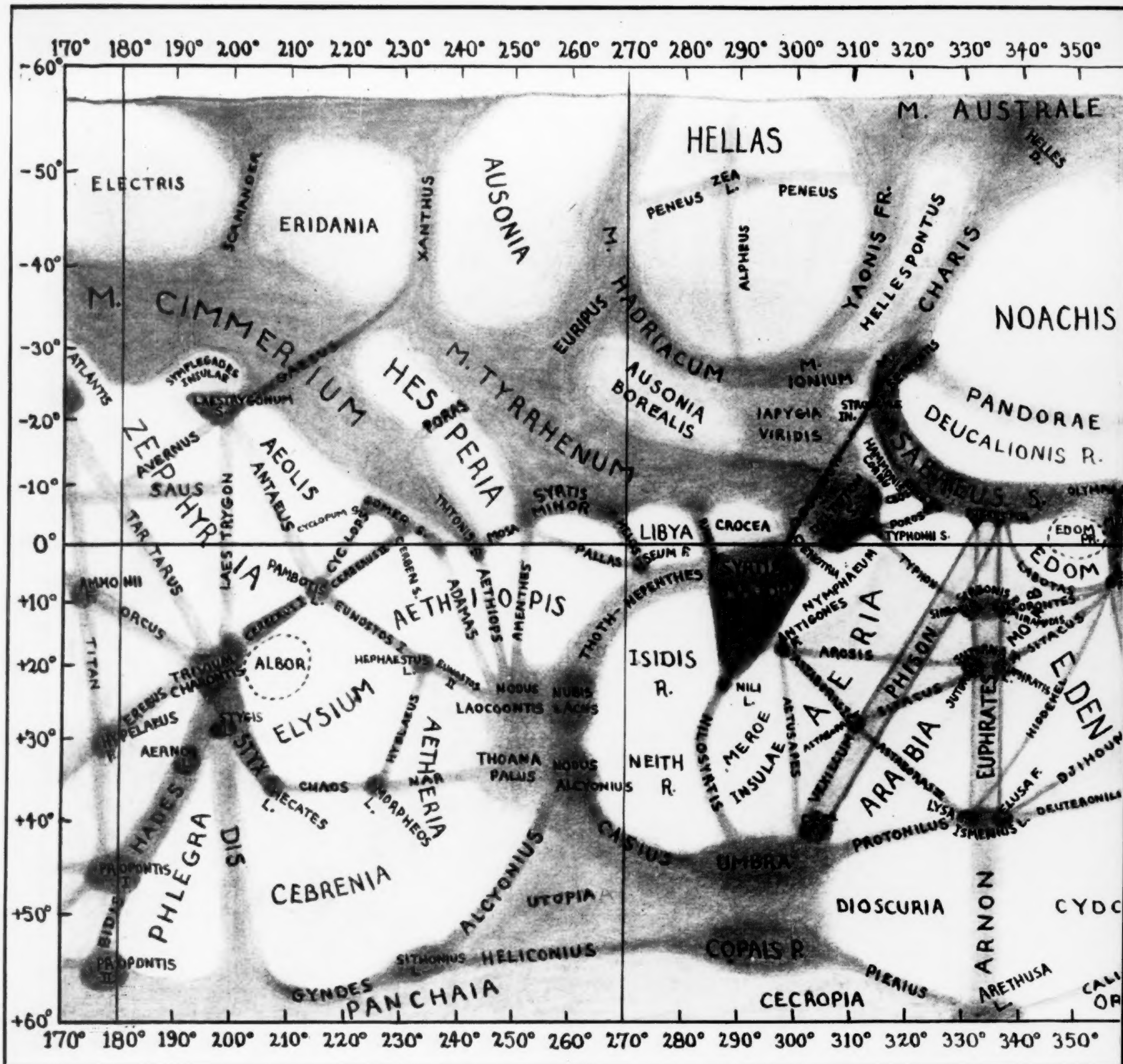
Linhof Professional De Luxe Tripod with geared center post, very rigid at this height of 48". Collapses to 37¼", extends to 82". Leather-covered platform, 4¾" dia. Attachment screw operates by knob on post bottom. Anodized aluminum alloy legs, 30-mm. dia., have convertible captive tips. Big rubber tips screw back to bare steel spikes. Weight only 17½ lbs. Price $169.50.



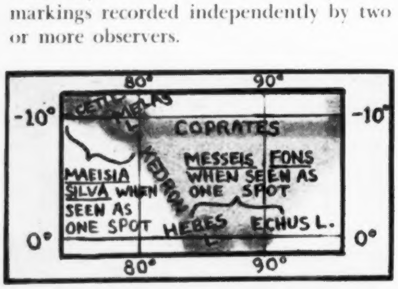
Precision Pan Head, holding Questar in polar equatorial position, with indexed tilt for any latitude. Pan Head base is tapped to standard ¼-20 screw size, to fit all camera tripods, and is priced at $38.50.

De Luxe Questar with all accessories, $995, (booklet on request); Field Model (without eyepieces), $495; both in handmade English leather cases. Questar 40x Eyepiece, $25; Questar Wide-Field Erfle Eyepiece, $25; Eyepiece Adapter Tube (only one required), $6; Questar Sun Filter, $25. Shipped prepaid in continental United States. Please consult us on suitable cameras and adapters.

QUESTAR CORPORATION
New Hope, Pennsylvania



THIS large, up-to-date map of the surface of the planet Mars has been compiled by D. P. Avigliano, Sierra Madre, Calif., from observations made during the favorable 1954 opposition by members of the Association of Lunar and Planetary Observers. It shows only those markings recorded independently by two or more observers.



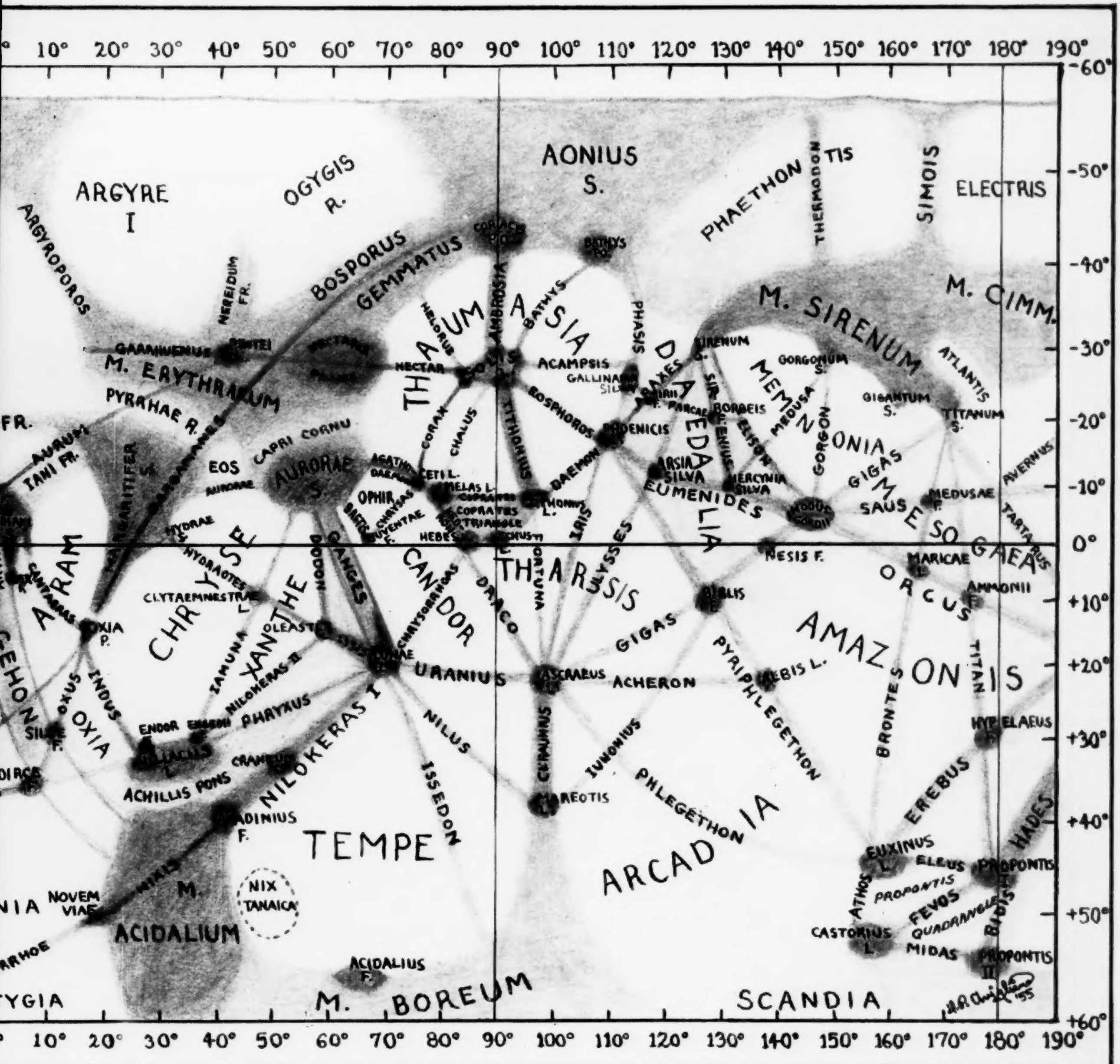
As in other Mars charts, north is at the bottom, and east to the left, matching the orientation in a telescope. The names of the markings are, for the most part, those used by Percival Lowell and E. M. Antoniadi. Additional names for recently detected details have been assigned by S. Ebisawa, T. R. Cave, Jr., and by Mr. Avigliano.

The following abbreviations have been used: D, Depressio (depression); F, Fons (spring); FR, Fretum (strait); IN, Insula (island); L, Lacus (lake); M, Mare (sea); P, Palus (swamp); PO, Portus (harbor); PR, Promontorium (cape); R, Regio (region); S, Sinus (gulf). Conventionally, the terms suggesting water are used for dark Martian markings, and those applicable to land for the bright reddish areas.

ALPO MAP

Unlike the stable lands and seas of Earth, the green areas of Mars change perceptibly and sometimes strikingly from one opposition to the next, spreading or shrinking, and darkening or fading. As a result, the Martian surface can never be mapped once and for all, and it is of much interest to compare this 1954 representation with earlier ones of the Martian surface.

Two Antoniadi maps of Mars have been reproduced in *Sky and Telescope*. On page 443 last month is one from his own observations of 1909 to 1937, and



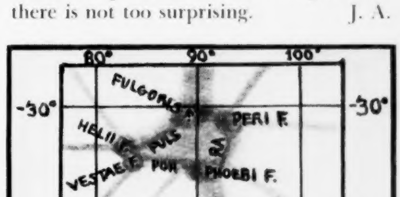
OF MARS

pages 268-9 of the June, 1954, issue contain a 1914 chart, based on observations by members of the British Astronomical Association. The former is much more crowded with detail, summarizing as it does three decades of work with a 33-inch telescope.

In comparing the maps, the reader should make allowance for the different modes of representation used by the two map makers, and for the exaggerated contrast needed to depict subtle shadings.

Any chart of Mars is necessarily a compilation from many sketches or photographs, each showing only a small sampling of the elusive detail. In piecing together these fragmentary views, the cartographer often has much difficulty in identifying isolated markings or canals. Even the best of Martian maps show some inconsistencies in identification. Thus the name Issedon (near longitude 80°, latitude 40° north) is not applied by Mr. Avigliano to the same feature as in the 1909-1937 map.

Erroneous positions can occur, if markings are inserted by estimation in a Mars map from a drawing. Careful measurements are desirable for their areographic longitudes and latitudes. The older maps of Schiaparelli, Jarry-Desloges, and Trumpler are noteworthy for the pains taken to secure accurate placement. But even if the cartographer is careful, the drawings from which he works may have their distortions. A particularly troublesome part of Mars is the Arcadia-Amazonis region at the lower right part of the 1954 map. Here the markings are mostly dim and vague, with few well-defined reference points, and so disagreement there is not too surprising. J. A.



BOOKS AND THE SKY

AMATEUR ASTRONOMER'S HANDBOOK

J. B. Sidgwick. The Macmillan Company, New York, 1955. 580 pages. $12.50.

OBSERVATIONAL ASTRONOMY FOR AMATEURS

J. B. Sidgwick. The Macmillan Company, New York, 1955. 358 pages. $10.00.

THESE TWO BOOKS fill what has recently been an annoying gap on the book shelf of the amateur astronomer. Though not intended as textbooks, both have a thoroughness and orderliness of presentation which give them the flavor of well-prepared textbooks. They are written primarily for the serious-minded amateur who has passed some of the first milestones of his avocation, such as his first homemade reflector, and a year or so of "sightseeing" among the planets, better known nebulae, double stars and clusters, and who is now seeking new worlds to conquer. Here Mr. Sidgwick's books meet a specific need.

Observational Astronomy for Amateurs outlines an imposing list of projects, or areas of astronomical endeavor, in which the amateur with modest equipment can engage with profit to astronomy and satisfaction to himself. The author does not stop at suggestions of what to do but adds specific and sometimes very detailed instructions on how to make and, in some cases, to reduce the observations.

When the amateur, stimulated by the foregoing book, chooses a project or area for some serious work in astronomy, he is quite likely to discover the inadequacy of his present telescope or perhaps its accessories. He may then turn to Mr. Sidgwick's companion volume, *Amateur Astronomer's Handbook*, where he will find a wealth of material on how to design, build, adjust, and maintain the instruments he will need. This reviewer was quite impressed with the breadth of coverage of optical topics in the first 10 sections. A few specific criticisms, some adverse, some complimentary, follow.

On pages 28-29, referring to light grasp or the limiting magnitude of a telescope, the author says that the objects most suitable for determining light grasp for any telescope are the stars of the north polar sequence and the comparison stars of variable stars. I should like to point out that in this country photoelectric observers are coming to rely heavily on the Johnson-Morgan standard stars, which are widely spaced around the sky; their magnitudes and colors have been carefully determined photoelectrically.

On pages 56-58, there is a very worthwhile discussion on the subject of upper limit of useful magnification, culminating with a convenient table for this quantity computed from several different formulas. Some good suggestions are given on pages 116-117 on the care which will extend the life of a metallic film on a mirror. On pages 198-199, the author has a good collection of methods for preventing and reducing the formation of dew on optical surfaces. On pages 198-202, the discussion of dewing up on the one hand and "tube currents" on the other, the most obvious remedies for which appear to oppose each other, should be valuable to amateur and professional alike. A very useful table on the characteristics of some of the better known photographic emulsions is given on page 360. But the homemade backing for a photographic plate described on page 362 sounds very messy, and we sincerely hope that no astronomer, amateur or professional, ever finds it necessary to carry out this operation.

One gets the impression from both books that the reader had better be not only enthusiastic and longing for new

worlds to conquer, but the possessor of a considerable quantity of this world's goods, because many of the undertakings proposed are going to be costly in at least one way other than the observer's time. For instance, on page 19 of *Observational Astronomy for Amateurs*, while discussing certain solar observations for an amateur, the author speaks of the necessity of a telescope from six to nine inches in aperture. Later, on page 53 he mentions spectroscopic attachments and an equatorial telescope clock driven at the solar rate. This comment is not intended as an adverse criticism, but simply as a statement of fact. If an individual observer is ruled out by the costs of certain proposed programs, here is an inspiring group project for an entire club!

Continuing with further discussion on this same book, we note that in Chapter 17, which deals with the subject of variables, nothing whatsoever is said about observing eclipsing stars. If amateurs can avail themselves of spectroscopes, they should not find photometers out of their reach. A minor error was noted in the footnote on page 267: For W Gem, one should read U Gem.

As a whole the books are well done and should be widely used by enthusiastic amateurs. Moreover, any professional astronomer will be glad for the collection of data and ideas in these two books. He will want them in his library. Finally, the professor or instructor of undergraduate courses in astronomy in our colleges and universities should find them of value to him as he plans lectures and laboratory periods.

THOMAS J. BARTLETT
Chamberlin Observatory
University of Denver

GUIDE TO MARS

Patrick Moore. Frederick Muller, Ltd., London. 1956. 124 pages. 10s 6d.

BESIDES being a prominent British amateur observer of the moon and planets, Patrick Moore is an energetic popularizer of astronomy. Since 1953 his name has appeared on the title pages of no fewer than nine books having to do with this science.

The latest of these is a smoothly written account of Mars for the amateur astronomer and general reader. Without resorting to technicalities, Moore gives a well-informed historical account of Martian observation, and surveys such current problems as the interpretation of the green markings and canals, the extent and composition of the planet's atmosphere, and the possibility of Martian life.

These problems are controversial, and while Mr. Moore stresses his own opinions he presents contrary views with much fairness. He believes that the Martian green markings represent vegetation of some sort. The main support for this appears to be E. Opik's argument that wind-blown dust would soon obliterate any surface feature that could not regenerate itself. To this reviewer it seems that our physical knowledge of the Martian surface is still too fragmentary for definite conclusions, and Mr. Moore's contention, "It is almost certain that extensive vegetation does exist on Mars," appears premature.

In this book are reproduced the two well-known photographs of Mars taken in red and blue light with the 200-inch Mount Palomar telescope. It is worth pointing out that these are not fair evidence of the capabilities of the 200-inch reflector for planetary work, as these photographs were not part of an extended program. Only when a very large number of exposures are made and the very best of these selected can the effectiveness of a large telescope for Martian photography be decided.

No one now believes in the existence of extensive bodies of water on Mars. It is sometimes maintained that even small ponds cannot be present, since otherwise we should sometimes observe a brilliant specular reflection of the sun from a water surface. This argument is briefly mentioned by Mr. Moore. However, two considerations make this observational test indecisive. Even a slight ruffling of the water surface by wind would make the reflection much fainter and perhaps unnoticeable—a point I have not seen mentioned in the literature. Also, specular reflection for Earth observers could occur only in a narrow equatorial zone on Mars; the test is inapplicable to the larger part of the planet's surface.

There is a large amount of information in the *Guide to Mars*, and factual errors seem to be very few and unimportant. They are minutiae such as citing the date 1840 for Beer and Mädler's map

of Mars (it was first published in 1830).

This attractive volume contains drawings and maps of the red planet, and there is a useful brief bibliography, which will allow the reader whose interest has been stimulated in Martian problems to follow them further.

J. A.

RECENT ADVANCES IN OPTICS

E. H. Linfoot. Oxford University Press, New York, 1955. 286 pages. $8.00.

IN THIS handsomely bound volume, one of England's foremost optical designers has treated with competent mathematical elegance those particular topics that are of primary interest to him and that highlight the contributions of the past 20 years.

In each problem, the author's final conclusions are obtained only after a thoroughly rigorous mathematical treatment, requiring much serious study by the reader who would digest all the material in the book. There is, however, an abundance of rewarding information contained in the numerous discussions and supplementary footnotes, which should make even a cursory reading of the work well worth while.

In Chapter I, a comprehensive development of the geometrical theory of optical images is given first. This unusual approach, using complex terms in the derivation of the Seidel aberration coefficients, proceeds very smoothly to the definition of the blur circle as the radius of gyration of the geometrical energy concentration for any given image patch. The minimization of this quantity as an effective technique in designing optimum anastigmatic systems, monochromatic systems, and Schmidt systems, is then illustrated.

Following this the problem of diffraction is considered, especially that of the secondary mirror obstruction in a reflecting telescope. The various cases are illustrated with diagrams, and the percentages of obscuration are compared with the maximum tolerable limits determined experimentally by the users of reflectors. Such insights as these into the fundamental nature of optical imagery should prove extremely valuable to the advanced amateur.

The chapter concludes with the author's previously unpublished work on the theory of partial coherency, which parallels H. H. Hopkins' contributions in this field. The bibliography here, and indeed throughout the book, is excellent.

In Chapter II, the author develops in minute detail the general diffraction theory inherent in the Foucault knife-edge testing procedure. The amateur telescope maker is certain to enjoy Dr. Linfoot's critical analyses of some of the shadow patterns that he has examined personally in his own experiments. For example, the precise description of the

test mirror appearance as the knife-edge traverses the Airy disk image formed by a truly spherical mirror is especially well done. There are some easily applied formulas for the error involved in determining surface quality as a function of the uncertainty of axial knife-edge location.

Several pages of schematic drawings are provided correlating typical mirror appearances for varying amounts of focus error and a true mirror surface. The opposite condition, of testing an image afflicted with primary spherical aberration, completes the pictorial presentation. The remainder of this chapter explores the interpretation of the shadow intensities in the presence of local zonal errors.

Especially valuable to those contemplating Schmidt-type systems and associated two-mirror arrangements are Chapters III and IV. In the first of these, Dr. Linfoot develops completely the sixth-order aberration function for Schmidt systems and for field-flattened systems. Formulas permit the calculation of off-axis image spreads when the system constants are known, and the determination of chromatic image spreads due to the color error of the correcting plate.

Then we are told of the methods for balancing the two limiting higher-order monochromatic errors of such systems, namely, lateral spherical aberration and a form of astigmatism. The procedure involves a slight additional figuring applied to the plate and a small amount of figuring on the mirror. The plate position is adjusted. The effect of these procedures on the image quality is clearly indicated by image-spot diagrams, which give a geometric representation of the energy concentrated in the image.

In the last chapter, we study the extremely powerful technique of "plate-diagram" analysis first originated by C. R. Burch to evaluate the Seidel properties of optical systems. This method assumes that any spherical surface, reflecting or refracting, may be anastigmatized by an aspherical correcting plate located at its center of curvature. The Schmidt camera is the simplest example, because it contains only one mirror surface and one correcting plate, but the author shows how the principle is easily extended to include any number of surfaces in an arbitrary optical system. This chapter exhaustively covers astronomical optical systems and is worth all the study the reader may devote to it.

In spite of its mathematical nature, this book should make an excellent addition to the library shelf of any amateur seriously interested in astronomical optics. The ambitious reader will develop his own interests by partaking of the author's broad experience in optical design.

ROBERT B. GALLIPEAU
Optical Laboratory
Boston University

NEW BOOKS RECEIVED

PROCEEDINGS OF THE WORLD SYMPOSIUM ON APPLIED SOLAR ENERGY, 1956, *Stanford Research Institute*, Menlo Park, Calif. 304 pages. $5.00.

This anonymously edited volume collects the papers presented by scientists and engineers at an international meeting held at Phoenix, Ariz., on November 1-5, 1955, to evaluate the practical uses of solar radiation. The contributions range from engineering specifications of solar motors to reports on tests of algae as energy converters.

LINES OF THE CHEMICAL ELEMENTS IN ASTRONOMICAL SPECTRA, *Paul W. Merrill*, 1956, *Carnegie Institution of Washington* Publication 610. 167 pages. $2.00 cloth, $1.60 paper bound.

For each element in turn, this monograph describes the occurrence of its spectral lines in astronomical bodies, and includes numerous references. Energy-level diagrams and lists of wave lengths are given for most of the astrophysically important elements.

THE CHANGING UNIVERSE, *John Pfeiffer*, 1956, *Random House*. 243 pages. $4.75.

The title hardly suggests that this book is entirely devoted to radio astronomy, and presents a broad picture of its rapid rise for the general reader and the amateur astronomer. Mr. Pfeiffer is among the best known American reporters of science to the public.

SOLID PROPELLANT ROCKETS, *Alfred J. Zaehringer*, 1955, *American Rocket Co.*, Box 1112, Wyandotte, Mich. 162 pages. $4.00, paper bound.

This is a general introduction primarily for engineers and scientists, with tables of performance data and lists of references. The major topics considered are interior and exterior ballistics, processing of solid propellants, static and dynamic testing, and applications.

ATLAS DES GESTIRNTEN HIMMELS, *Otto Kohl* and *Gerhard Felsmann*, 1956, *Akademie Verlag*, Mohrenstrasse 39, Berlin W8, Germany. 16 charts. DM 15.

The "Atlas of the Starry Skies" shows the stars through magnitude 6.0 over the entire sky on eight large charts, drawn for the epoch 1950. There are also detail maps of the Pleiades, Hyades, and Praesepe, to magnitude 10.5, keyed moon photographs, and illustrations of solar system objects.

THE EXPLORATION OF MARS, *Willy Ley* and *Wernher von Braun*, 1956, *Viking*. 176 pages. $4.95.

The contents of this popularly written book are about equally divided between a historical summary of Martian observations and theories, and an imaginative account of rocket travel to Mars. There are many drawings and photographs of the red planet; reproductions of Chesley Bonestell paintings illustrate space flight themes.

GUIDE TO MARS, *Patrick Moore*, 1956, *Frederick Muller, Ltd.*, 110 Fleet St., London E. C. 4. 124 pages. 10s 6d.

A well-known British amateur and popularizer of astronomy gives a brief, non-technical account of the red planet and some of its problems. Included are suggestions on how to observe Mars with small telescopes.

ASTRONOMIE POPULAIRE, *Camille Flammarion*, completely revised by *Gabrielle Camille Flammarion* and *André Danjon*, 1955, Observatoire de Juvisy, Seine-et-Oise, France. 609 pages. About $15.00.

This classic, in French, on popular astronomy has now been brought up to date by a distinguished group of Gallic astronomers. The handsomely illustrated volume includes 819 photographs and diagrams, plus seven color plates and two large fold-out constellation maps. Two-thirds of the book is devoted to the solar system, and the coverage of specific topics reflects the interests of a planetary observer.

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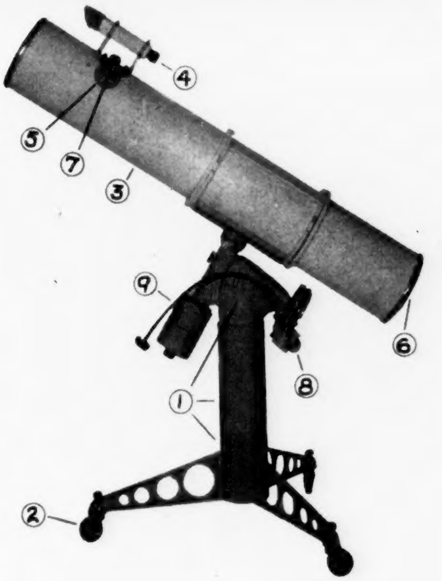

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GLEANINGS FOR ATM's

EDITED BY EARLE B. BROWN

Notes on Basic Optics — XXI

T. Catadioptric Systems – continued

In recent years, there has been a steady growth in popularity of catadioptric telescopes—those in which the primary image is formed by a lens-mirror combination. As described in this series for August, some designs of this type have marked advantages over standard reflectors and refractors for visual and photographic observation. This installment continues our description of the catadioptric systems of particular importance for astronomical uses.

3. **The Maksutov Telescope.** D. D. Maksutov is usually credited with first presenting the form of instrument shown in Fig. 63A. His arrangement much resembles the Schmidt camera, but a thick meniscus lens takes the place of the aspheric correcting plate to overcome the spherical aberration of the primary mirror. The lens has the important advantage that its surfaces are both spherical, so no fourth-order surface figure has to be made, but the lens does not give complete cancellation of spherical aberration.

In the best design of the Maksutov system, the aperture stop is placed at the center of curvature of the primary mirror, and coma and astigmatism of the third order are absent. But even without having the tube length as long as this design requires, and using the meniscus position as the aperture stop, the telescope will have residual aberrations many times smaller than those of the ordinary achromatic refractor.

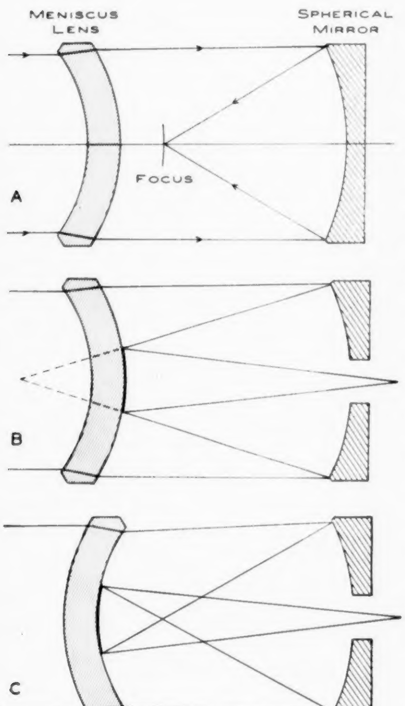

Fig. 63. Types of Maksutov telescopes.

Thus, a Maksutov may be made with a shorter tube length than a Schmidt of similar construction, but like the Schmidt a Maksutov has a strong Petzval curvature, necessitating bending the photographic plates to match the focal surface.

During World War II, S. Bouwers in Holland independently developed several systems of this type, but announcement of their design was delayed until the German occupation was over. His most highly corrected system is "concentric," with a Schmidt-type correcting plate at

Fig. 64. A Hindle design of an off-axis Maksutov telescope for visual use.

the center of curvature of both the meniscus lens and the primary mirror. This combination eliminates third-order coma and astigmatism, as well as the last vestiges of spherical aberration.

In his original article, Maksutov describes, illustrates, and gives constructional formulas for many modifications of his basic design. For instance, the correcting lens can have an aluminized central spot and be placed inside the focus to intercept the converging rays, as shown in Fig. 63B. The primary mirror is perforated, and the arrangement is that of a Cassegrainian reflector. Systems of this type are now on the market as long-focus or telephoto camera lenses. In a like manner, the lens can be reversed and placed outside the focus to give the over-all effect of a Gregorian instrument (Fig. 63C). In any of these forms, the Maksutov is equivalent for astronomical purposes to a Schmidt, especially if the focal ratio is greater than f/1.

The symmetrical spherical optics of the Maksutov permit its use as an off-axis or Herschelian telescope. The meniscus does not even have to be placed in the entrance rays of the instrument, but can be made smaller, as seen in Fig. 64, taken from the article by J. S. Hindle in our February, 1953, issue.

In the professional shop, with suitable equipment, the spherical surfaces of the Maksutov meniscus lens are certainly easier to fabricate than the aspheric

correcting plate of the Schmidt. And for advanced amateurs, a Maksutov should not prove too troublesome, but the curves are steep and difficult to test with the Foucault knife-edge. Radii, thickness, and concentricity have to be held to fairly strict tolerances, and alignment is very critical in the finished telescope. But its closed tube makes a Maksutov a vast improvement over an ordinary reflector.

The cost of the large piece of optical glass for the meniscus lens, which has to be of grade A quality, is the greatest deterrent to amateur construction of a Maksutov. A sizable disk is needed, because the meniscus is thick, with steep curves.

4. **The Baker-Schmidt Camera.** In 1940, James G. Baker described a new type of catadioptric system, which has since been known as the Baker camera or the Baker-Schmidt. It is a two-mirror combination with a correcting plate, both mirrors having the same radius of curvature. The Petzval surface is flat, spherical aberration of all orders is corrected, and, with proper location of the aperture stop, coma and astigmatism are very small.

Either of the mirrors, not both, may be made spherical, but the other mirror then departs very little from a sphere. Since both mirrors have the same basic radius, they may be ground against each other, one being concave and the other convex. The correcting plate is easier to fabricate than that of a Schmidt camera, as it is less strongly curved. Thus, the Baker camera has the advantages of a flat focal plane, shorter tube length, and relative ease of manufacture. The aspheric surface on the corrector and the slight figuring of one of the mirrors are not beyond the capabilities of many experienced amateur telescope makers.

In the November-December, 1939, issue of *The Telescope*, the drawings of Fig. 65 were first published, comparing early Baker designs with the conventional Schmidt (C). All three of these systems have the same equivalent focal length, the same light-gathering power, and the same area of photographic plate over which the image illumination is uniform. But the very short tube length of Camera A is achieved with non-spherical optical surfaces, and this form would be difficult to manufacture. Camera B represents the general Baker design, and indicates the proximity of the focal plane to the primary mirror. If the latter is perforated, then the focal plane is easily accessible from the back of the telescope tube, another advantage over the Schmidt.

A large instrument of this form was installed at Harvard's Boyden Station in South Africa late in 1949; it is known as the ADH telescope. It has a 36-inch primary mirror, 32-inch correcting plate, and covers a field of five degrees on 10-inch diameter photographic plates.

5. **The Schupmann Telescope.** Like Bernhard Schmidt's camera, the invention of Ludwig Schupmann lay dormant for some time. In his system, shown in Fig. 66, there is no "correction by definition," but balancing of spherical aberration and coma, as well as of Petzval curvature, is

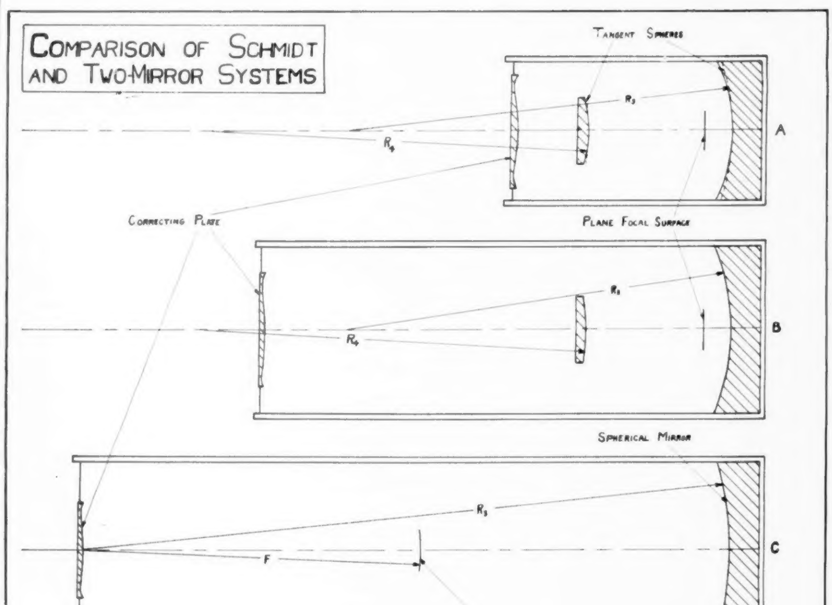

Fig. 65. The Baker-Schmidt and conventional Schmidt systems compared.

achieved by the combination of a concave Mangin mirror and a weak positive objective lens. A large amount of astigmatism, however, is a major weakness of this design.

The Mangin mirror is a back-surfaced concave mirror with, in general, a different curvature on the front and back surfaces—it is equivalent to a concave mirror plus an equiconcave lens. Its negative spherical aberration corrects the positive aberration of the weak single-element objective. By placing the lens in the entrance pupil, the required size of the Mangin mirror is reduced. The diagonal, however, intercepts a considerable amount of light and introduces diffraction. Both objective and corrector are made of optical glass of the same

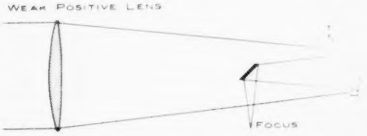

Fig. 66. The Schupmann system.

index, and that for the Mangin mirror must be of excellent quality, as the light passes through it twice.

Baker has improved the design to eliminate the diagonal obstruction by tilting the Mangin corrector so the image falls outside the converging light beam from the large lens. But to compensate for this one of the surfaces must be slightly toric or cylindrical. The instrument is quite long in Baker's version, but it is possible to fold it with optical flats if the light loss can be tolerated.

The largest Schupmann-Baker telescope is the 16-inch at the Sacramento Peak Observatory built by Boston amateur James W. Gagan (see the August issue). The largest amateur-owned instrument is that of Chester Cook, also of the Boston group, who has made an 8-inch to Baker's specifications.

Baker has also used the Schupmann scheme to achieve complete color correction of an astronomical refractor. This system offers unusual promise for planetary observations. If one possesses a fine refractor over six inches in aperture, such an improvement is well worth considering, but fabricating the optics is a project for the advanced telescope maker or the professional optician.

6. **The Reflector-Corrector.** Possessors of 12-inch reflectors and larger might find the Baker design of the reflector-corrector worthy of study. A weak Schmidt-type correcting plate is placed over the end of the tube (inside the focus of the large mirror), and supports in its center a positive achromatic lens. These correct the main paraboloid to produce a flat-field photographic instrument of high quality. The advantage of the reflector-corrector is that it may be made

Aberrational Characteristics of Catadioptric Systems

System	Spher. Aber.	Coma	Astig.	Petz.	Chrom. Aber.	Sphero-Achrom.
Spherical Mirror	3	0′	0′	3	0	0
Paraboloidal Mirror	0	3	0‴	3	0	0
Schmidt Camera	0	0″	0″	3	0	1
Wright Camera	0	2	2	3	0	1
Maksutov Telescope	1	0′	0′	3	1	1
Bouwers Concentric	0	0″	0″	3	1	1
Schupmann Telescope	1	1	3	1	1	1
Baker-Schmidt	0	1	1	0	0	1
Reflector-Corrector	0	1	1	1	1	1

0 Zero or absent   1 Residual   2 Significant   3 Heavy

0′ Dependent on stop position; zero to third order if stop and corrector are at center of curvature.

0″ Zero to third order only.

0‴ Stop at focus gives zero astigmatism.

interchangeable with the usual Newtonian diagonal, so the instrument can be used for ordinary visual and photoelectric observations simply by removing the reflector-corrector from the top of the main tube. The best-known telescope of this design is the 24-inch of the Dyer Observatory near Nashville, Tenn.

The accompanying table summarizes the aberrational characteristics of the catadioptric systems we have discussed. The number symbols indicate roughly the relative importance of the aberrations, and not their quantitative values.

This series of articles on basic optics, which began in May, 1953, ends at a point where further discussion might be more advanced than the average telescope maker would want to study. It is hoped that many readers have found the presentation of value.

E. B. B.

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OBSERVER'S PAGE

Universal time is used unless otherwise noted.

The Return of Comet Olbers (1956a)

SHORTLY after sunset on September evenings, telescope observers will be able to view Comet Olbers low in the southwestern sky, as it moves from the constellation Virgo into Libra. This is the second recorded return of the periodic comet first detected by W. Olbers in 1815, and recovered by the American comet hunter W. R. Brooks in 1887. Its period is at present 69.6 years. At aphelion, Comet Olbers is outside the orbit of Neptune.

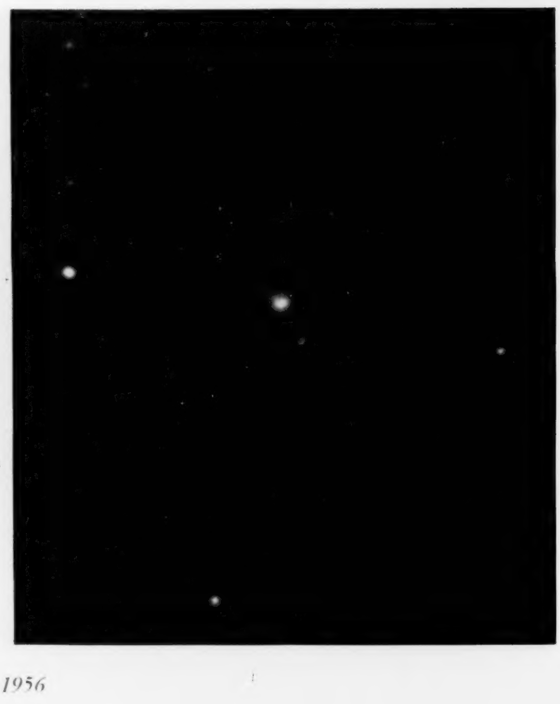
The first recognition of Comet Olbers on its present return was on photographs taken January 4 and 9, 1956, by Antonin Mrkos in Czechoslovakia. These showed a tiny diffuse 16th-magnitude object in Eridanus—five magnitudes fainter than had been expected. Soon afterward, G. Van Biesbroeck found 19th-magnitude images of the comet on two plates he had taken on November 12, 1955, with the 82-inch McDonald Observatory reflector.

The comet was closest to the sun on June 19th, at 1.18 astronomical units. The accompanying photograph of June 30th shows its appearance at about the time of greatest brilliancy, magnitude 7.

On July 5th, John B. Priser, Albuquerque, N. M., accidentally picked up the comet, then near the boundary of Ursa Major and Leo Minor, with 7 x 50 binoculars. Unaware that it was a known object, he followed its southeasterly motion from night to night. Between July 6th and 14th, he obtained 18 photographs of it with a homemade camera, whose $3\frac{1}{2}$-inch Cooke-type lens has a focal length of 12 inches. The camera has a plywood box, which is strapped to Mr. Priser's Skyscope reflector for hand guiding.

Comet Olbers is now gradually fading as it recedes from both the sun and earth, but it is not expected to be fainter than magnitude 9 during the period covered by the accompanying ephemeris, computed by H. Q. Rasmusen. This should allow amateurs to search for the comet

Above: Dr. Van Biesbroeck used the Yerkes Observatory 24-inch reflector for this photograph of Olbers' comet on June 30th. The original negative shows the tail as one degree long, corresponding to 2.6 inches on this enlargement.



Left: Mr. Priser used his homemade f/3.5 camera for this picture of Comet Olbers, on July 8, 1956, at 9:30 p.m. MST. The exposure was four minutes on Super Panchro Press film, developed five minutes in D19. The reproduction scale is $2\frac{3}{4}$ inches per degree.

with telescopes of moderate size. The ephemeris lists the 1950 right ascension and declination of Comet Olbers at 0^h Universal time for each date given. (This corresponds to 7:00 p.m. Eastern standard time for the preceding date.)

August 30, $13^h\ 30^m.2$, $+16°\ 59'$. **September 4,** $13^h\ 44^m.3$, $+14°\ 25'$; **9,** $13^h\ 57^m.7$, $+11°\ 57'$; **14,** $14^h\ 10^m.5$, $+9°\ 36'$; **19,** $14^h\ 22^m.6$, $+7°\ 23'$; **24,** $14^h\ 34^m.3$, $+5°\ 17'$; **29,** $14^h\ 45^m.5$, $+3°\ 19'$.

October 4, $14^h\ 56^m.4$, $+1°\ 28'$; **9,** $15^h\ 06^m.9$, $-0°\ 16'$; **14,** $15^h\ 17^m.1$, $-1°\ 53'$.

DEEP-SKY WONDERS

THERE is no up-to-date and complete catalogue of sky objects for the amateur astronomer today which is generally available, but the great amount of information in the Skalnate Pleso *Atlas of the Heavens* is rapidly making it a standard observing aid. Since this atlas plots the nebulae from professional lists, many extremely faint objects are included. Nevertheless, most of them are within reach of amateur telescopes at least 10 inches in aperture. If the nebula is among the discoveries of Sir William Herschel a century and a half ago, the amateur with such an instrument can almost always expect to find it. All four of the planetary nebulae described this month were first listed by Herschel.

NGC 6894, at $20^h\ 14^m.4$, $+30°\ 25'$ (1950), is a planetary in Cygnus, which photographs show as a faint diamond ring 44 seconds of arc in diameter. Although it has been catalogued as magnitude 14.4, amateurs can see it, and James Wolfe writes that it seems brighter to him than the catalogue values. James Corn, of Phoenix, Ariz., observed it on July 16, 1952, as magnitude 12 and large.

In Sagitta, NGC 6905 has the 1950 co-ordinates, $20^h\ 20^m.2$, $+19°\ 57'$. This well-known object is 44″ by 37″ in angular size, and while listed as magnitude 12 is visible in a 4-inch. Admiral Smyth describes it as lying in a coarse cluster, and Corn notes that this nebula requires high powers.

At $20^h\ 59^m.1$, $+54°\ 21'$ in Cygnus, NGC 7008 is a rather curdled glow, 86″ by 69″ in size, and listed as magnitude 13. Corn on June 30, 1953, saw it as large and dim, with one star inside. Herschel did not recognize this as a planetary.

By far the easiest of these four planetaries is NGC 7009 in Aquarius, named the Saturn nebula by Lord Rosse. Its 1950 position is $21^h\ 01^m.4$, $-11°\ 34'$, and it is 44″ by 26″ in angular size, with a 12th-magnitude central star. Corn comments on the green color of this 8th-magnitude planetary, which can be found with very small telescopes, and is usually visible in finders. In large instruments its appearance has inspired much praise.

WALTER SCOTT HOUSTON
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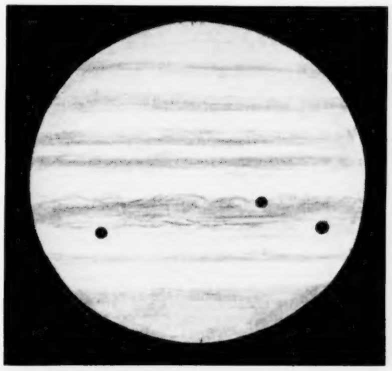
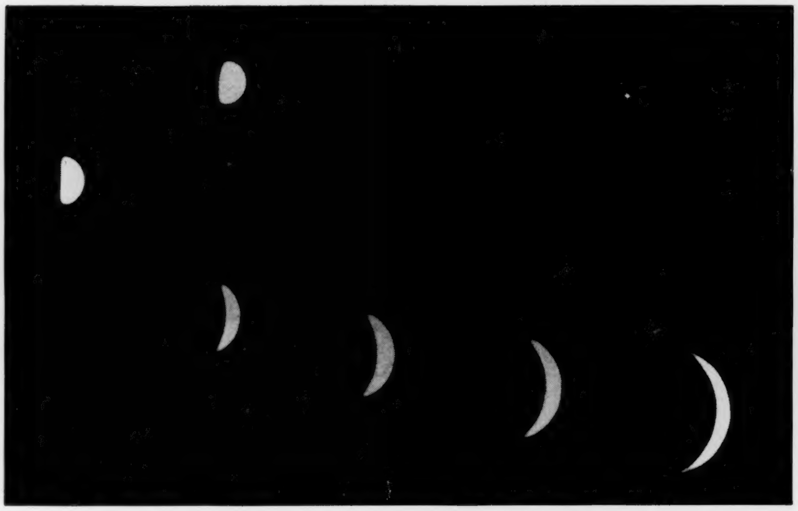
SATELLITE SHADOWS ON JUPITER

At Marseilles, France, using a 10-inch telescope, A. C. Larrieu made the accompanying drawing of the planet Jupiter, on April 21, 1956, at 21:30 Universal time. Its principal feature is that the shadows of three of the Galilean satellites appear projected on the planet's disk. South is upward, as in an astronomical telescope, and the shadows were moving from right to left. In this order, they are of satellites **III**, **I**, and **IV**.



At this time, satellite **I** was in transit in front of Jupiter, but it is not shown in the drawing, and **III** and **IV** were to the left of the disk, having ended their transits. The other bright moon of Jupiter, **II**, was occulted behind the planet.



These six photographs of Venus in 1956 show how it changed from a gibbous phase to a narrow crescent, meanwhile growing in apparent size, between March 3rd and June 8th. Photograph by Roland Rustad, Jr.

Photographs of Jupiter and Venus

In view of Hans Pfleumer's articles on amateur photography (January-April issues), readers might be interested in my efforts along that line.

I took this picture of Jupiter on March 14th, a month after the planet's opposition to the sun. The film used was Adox KB-14, exposed for ½ of a second. The print was enlarged 21 times.

The series of Venus is actually a montage of photographs taken separately on March 3rd, April 9th, May 17th, May 23rd, June 2nd, and June 8th, the last shot being made two weeks before inferior conjunction. These were enlarged 14 times from Microfile film exposed for ½ of a second.

All of my photographic work is done through a 6-inch reflector of 75 inches focal length, with a 3-inch refractor mounted with it for guiding. For pictures of the moon I use 35-mm. film at the focal plane of the mirror. For the planets, a Barlow lens inserted into the system gives me an equivalent focal length of 225 inches. The film I use is Kodak Microfile or Adox KB-14, the latter being five times faster but five times as grainy.

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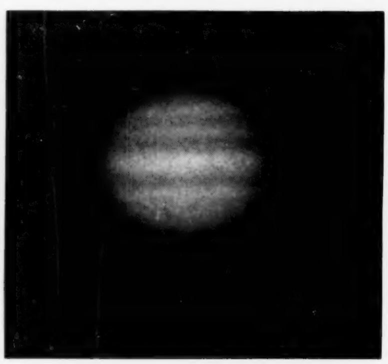
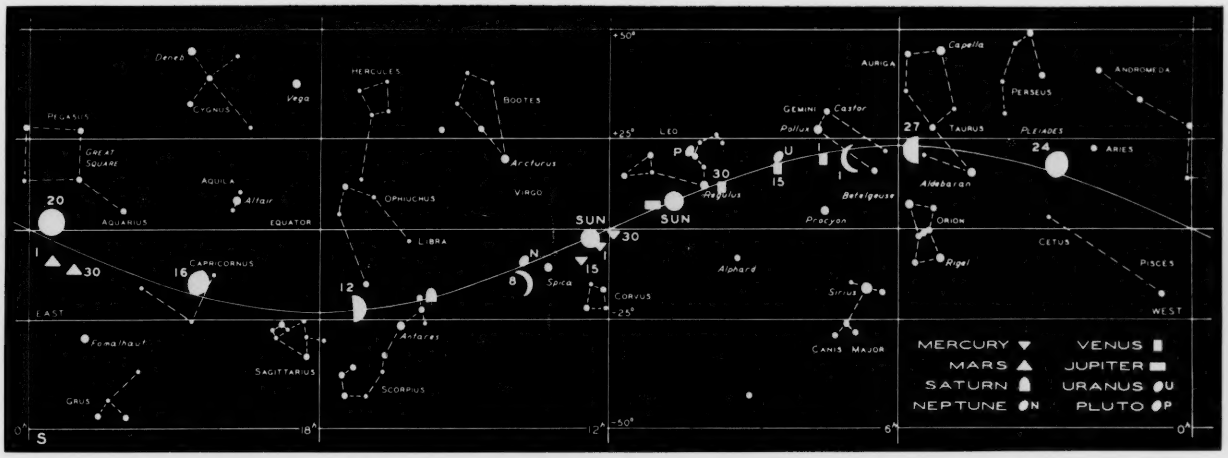


Jupiter's belts, zones, and elliptical disk are clearly shown in Mr. Rustad's photograph with his 6-inch reflector on March 14, 1956.



THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month or for other dates shown.

Mercury will be poorly situated for viewing this month, as it passes inferior conjunction with the sun on the 26th, entering the morning sky at that time.

Venus continues bright in the morning sky, now moving slowly toward the sun after having passed elongation on August 31st. In mid-September, the planet rises 3½ hours before the sun, appearing at magnitude −3.8. The disk of Venus will have shrunk to 20″.6 and its area of illumination to 57 per cent on the 15th.

The earth arrives at heliocentric longitude 0° on September 23rd at 01:36 UT, when autumn commences in the Northern Hemisphere and spring in the Southern Hemisphere.

Mars attains its most favorable opposition in 17 years on September 10th at 22^h UT, according to the *American Ephemeris*, at which time it will be 35,200,000 miles from the earth. Actually, Mars is nearest to us on the 7th, and during the first half of the month will shine at magnitude −2.6. The planet will be in retrograde motion in Aquarius and visible through the night. On the 7th, the planetary disk will be 24″.76 in diameter. For further information, see the April issue, pages 256-257; the June issue, page 377; and the August issue, pages 467-469.

Jupiter passes conjunction with the sun on September 4th, becoming visible in the dawn during the last week of the month.

Saturn may be seen in the southwestern sky for about 2½ hours after sunset during most of September. Shining at magnitude +0.8, the ringed planet continues moving eastward in Libra.

Uranus can be observed in the morning hours as a 6th-magnitude object, located about 1½° west of the Beehive cluster in Cancer. Venus passes 2° 15′ south of Uranus on the 11th at 6^h UT, the pair rising 3½ hours before the sun.

Neptune, due to its proximity to the sun in the evening sky, cannot be seen this month.

E. O.

UNIVERSAL TIME (UT)

TIMES used on the Observer's Page are Greenwich civil or Universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the UT before subtracting, in which case the result is your standard time on the day preceding the Greenwich date shown.

CANADIAN CONSTELLATION CHARTS

A booklet of simplified star maps, for learning the principal constellations visible from latitude 50° north, has recently been published by the Dominion Astrophysical Observatory, Victoria, B. C. There are two charts for each month, one showing the heavens viewed by an observer facing north, the other for an observer looking south. White dots on a blue background represent stars down to about the 3rd magnitude, together with some fainter ones which help to indicate the constellation figures. Canadian observers can obtain a copy on request by writing to the Dominion Astrophysical Observatory.

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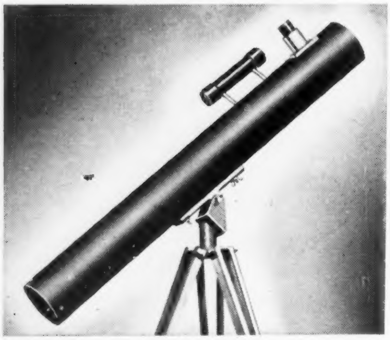

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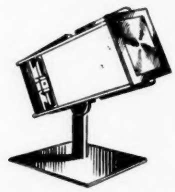

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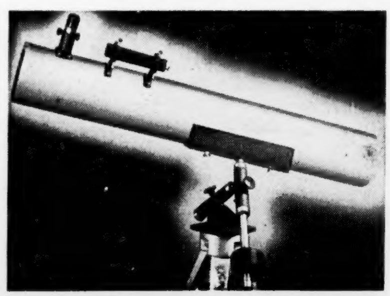

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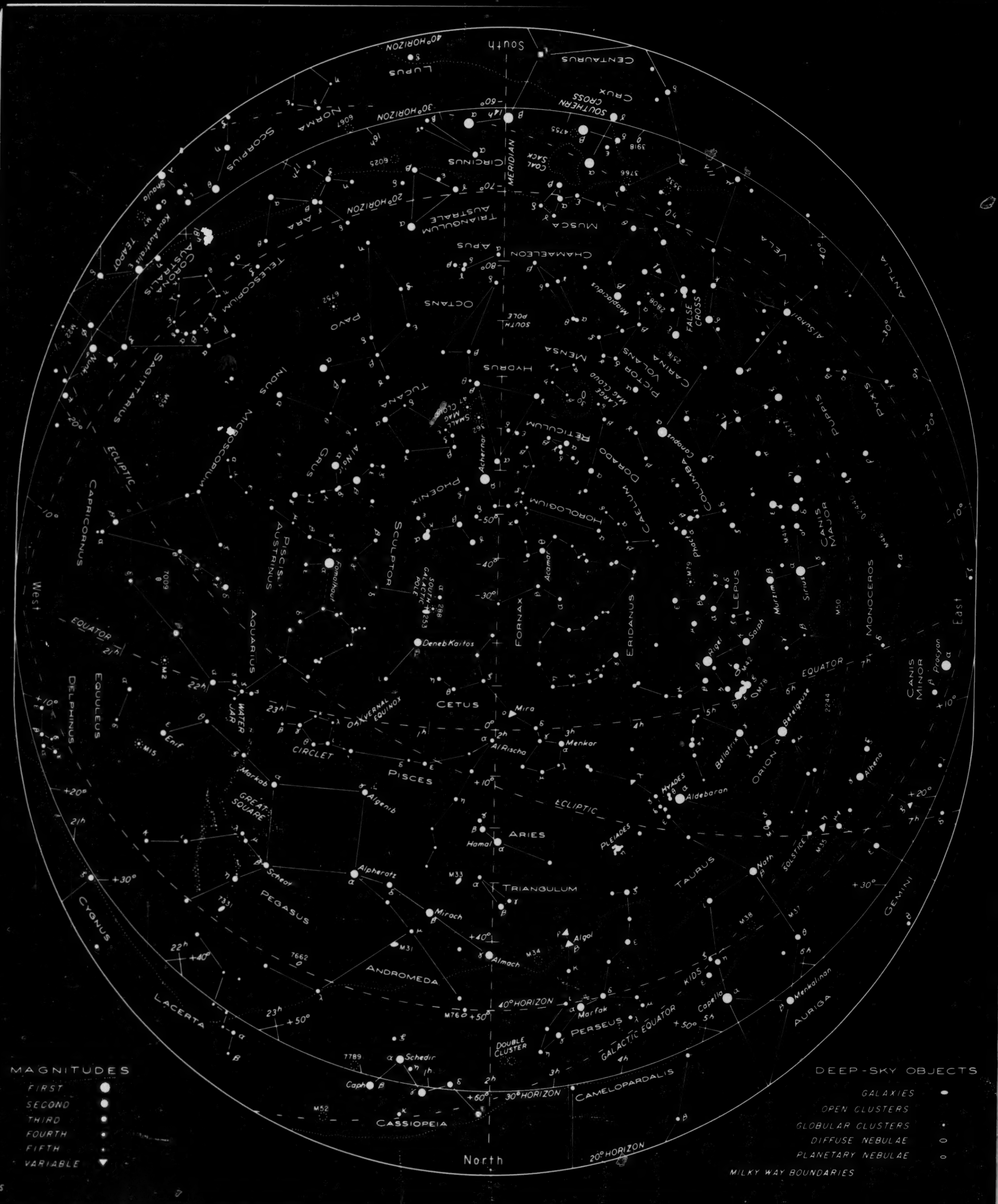
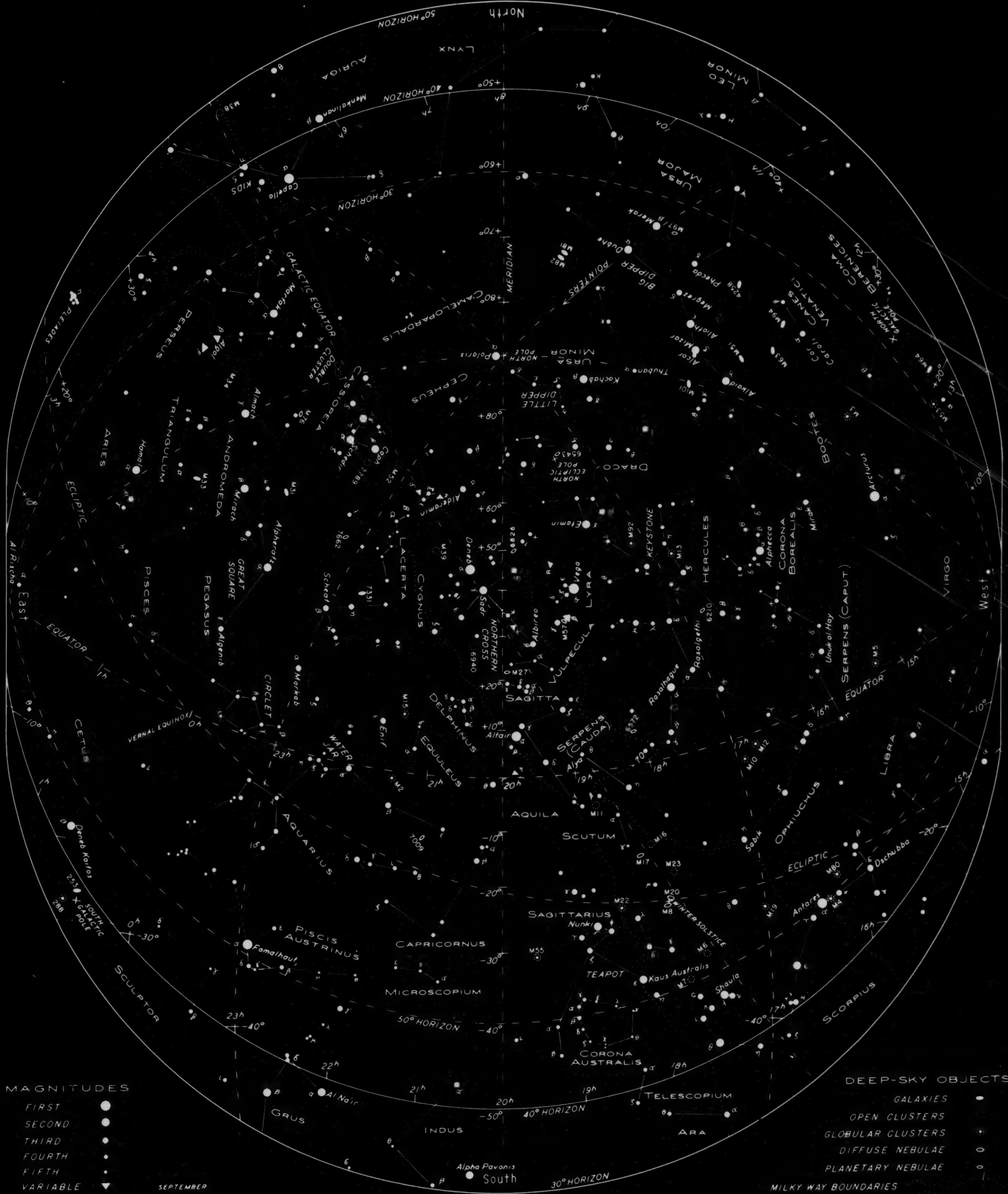


SOUTHERN STARS

The sky as seen from latitudes 20° to 40° south, at 11 p.m. and 10 p.m., local time, on the 7th and 23rd of November, respectively; also at 9 p.m. and 8 p.m. on December 7th and 23rd. For other dates, add or subtract ½ hour per week.

At the chart time, the striking 1st-magnitude stars of summer are climbing into the eastern sky, from Capella far in the northeast to Alpha and Beta Crucis low in the south. Close to the north point of the horizon, look for the Double Cluster in Perseus.



STARS FOR SEPTEMBER

The sky as seen from latitudes 30° to 50° north, at 9 p.m., and 8 p.m., local time, on the 7th and 23rd of September, respectively; also at 7 p.m. and 6 p.m. on October 7th and 23rd. For other dates, add or subtract ½ hour per week.

During these clear, moonless September nights the Milky Way can be seen to best advantage, spanning the sky through the zenith. Note the great dark rift extending from Cygnus through Aquila, and the bright star clouds in Scutum and Sagittarius.

MOON PHASES AND DISTANCE

New moon	September 4, 18:57
First quarter	September 12, 0:13
Full moon	September 20, 3:19
Last quarter	September 27, 11:25
New moon	October 4, 4:24

September		Distance	Diameter
Perigee	3, 4h	224,300 mi.	33′ 06″
Apogee	15, 5h	251,700 mi.	29′ 30″
October			
Perigee	1, 2h	227,400 mi.	32′ 39″

OCCULTATION PREDICTIONS

August 29-30 **Zeta Tauri** 3.0, 5:35.0 +21-07.1, 24, Im: **E** 10:54.1 −1.7 +0.3 104; **F** 10:44.3 −2.2 −1.4 133; **H** 10:18.0 −0.5 +1.1 89; **I** 10:41.4 −0.1 +2.5 48. Em: **F** 11:39.3 −1.5 +3.4 221; **H** 11:23.2 −0.9 +1.3 261; **I** 11:30.7 −1.1 +0.2 306.

August 30-31 **Nu Geminorum** 4.1, 6:26.4 +20-14.5, 25, Im: **A** 6:39.6 +0.5 +2.4 44; **B** 6:48.7 +0.8 +3.4 29. Em: **A** 7:18.2 −0.7 −0.2 317; **B** 7:15.5 −1.0 −1.1 332; **C** 7:15.7 −0.5 0.0 310; **D** 7:12.1 −0.9 −1.2 334.

September 24-25 **Omega Tauri** 4.8, 4:14.7 +20-28.3, 21, Em: **C** 9:59.1 −2.1 +0.1 259; **D** 9:53.5 −1.9 −0.5 275; **E** 9:30.4 −2.1 +0.4 267; **F** 9:06.5 −1.9 +1.8 242; **H** 8:36.2 −1.4 +0.6 284.

For stations in the United States and Canada, usually for stars of magnitude 5.0 or brighter, data from the *American Ephemeris* and the *British Nautical Almanac* are given here, as follows: evening-morning date, star name, magnitude, right ascension in hours and minutes, declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, UT, **a** and **b** quantities in minutes, position angle on the moon's limb; the same data for each standard station westward.

The **a** and **b** quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude, respectively, enabling computation of fairly accurate times for one's local station (long. **Lo**, lat. **L**) within 200 or 300 miles of a standard station (long. **LoS**, lat. **LS**). Multiply **a** by the difference in longitude (**LO** — **LoS**), and multiply **b** by the difference in latitude (**L** — **LS**), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard station predicted time to obtain time at the local station. Then convert the Universal time to your standard time.

Longitudes and latitudes of standard stations are:

A	+72°.5,	+42°.5	**E**	+91°.0,	+40°.0
B	+73°.6,	+45°.5	**F**	+98°.0,	+31°.0
C	+77°.1,	+38°.9	**G**	Discontinued	
D	+79°.4,	+43°.7	**H**	+120°.0,	+36°.0
I	+123°.1,	+49°.5			

VARIABLE STAR MAXIMA

September 1, V Canum Venaticorum, 131546, 7.1; 1, T Centauri, 133633, 6.1; 8, R Phoenicis, 235**150**, 7.8; 16, T Herculis, 180531, 8.0; 16, T Cephei, 210868, 5.8; 21, RS Scorpii, 164**844**, 6.8; 22, R Centauri, 140**959**, 5.9; 23, R Sculptoris, 012**233**, 5.8; 23, U Cygni, 201647, 7.6; 30, X Monocerotis, 065**208**, 7.6.

These predictions of variable star maxima are by the AAVSO. Only stars are included whose mean maximum magnitudes are brighter than magnitude 8.0. Some, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern), and the predicted magnitude.

PREDICTIONS OF BRIGHT MINOR PLANET POSITIONS

Julia, 89, 9.1. September 4, 0:38.6 +27-28; 14, 0:30.6 +28-53; 24, 0:20.4 +29-43. October 4, 0:09.3 +29-51; 14, 23:59.1 +29-24; 24, 23:51.3 +28-31.

Papagena, 471, 8.6. September 14, 1:13.9 −19-44; 24, 1:07.5 −20-50. October 4, 0:59.3 −21-28; 14, 0:50.6 −21-36; 24, 0:42.7 −21-11. November 3, 0:36.8 −20-10.

Ceres, 1, 7.6. September 14, 1:30.8 −6-17; 24, 1:24.3 −7-09. October 4, 1:16.4 −7-57; 14, 1:07.9 −8-34; 24, 0:59.6 −8-55. November 3, 0:52.3 −8-59.

After the asteroid's name are its number and the magnitude expected at opposition. At 10-day intervals are given its right ascension and declination (1950.0) for 0h Universal time. In each case the motion of the asteroid is retrograde. Data are supplied by the IAU Minor Planet Center at the University of Cincinnati Observatory.

MINIMA OF ALGOL

September 1, 4:10; 4, 1:29; 6, 22:17; 9, 19:06; 12, 15:54; 15, 12:43; 18, 9:32; 21, 6:20; 24, 3:09; 26, 23:58; 29, 20:46. October 2, 17:35; 5, 14:23; 8, 11:12.

These minima predictions for Algol are based on the formula in the 1953 *International Supplement* of the Krakow Observatory. The times given are geocentric; they can be compared directly with observed times of least brightness.

SUNSPOT NUMBERS

June **1**, 94, 98; **2**, 102, 107; **3**, 97, 117; **4**, 92, 106; **5**, 114, 117; **6**, 107, 118; **7**, 98, 111; **8**, 79, 90; **9**, 91, 85; **10**, 90, 89; **11**, 81, 87; **12**, 93, 94; **13**, 92, 98; **14**, 110, 108; **15**, 104, 114; **16**, 120, 132; **17**, 114, 120; **18**, 118, 130; **19**, 145, 171; **20**, 162, 166; **21**, 146, 162; **22**, 116, 150; **23**, 127, 139; **24**, 103, 125; **25**, 90, 106; **26**, 55, 70; **27**, 63, 71; **28**, 95, 122; **29**, 128, 135; **30**, 153, 162. Means for June: 106.0 American; 116.7 Zurich.

Above are given the date, the American number, then the Zurich number. These are observed mean relative sunspot numbers, the American computed by D. W. Rosebrugh from AAVSO Solar Division observations, the Zurich numbers from Zurich Observatory and its stations in Locarno and Arosa.

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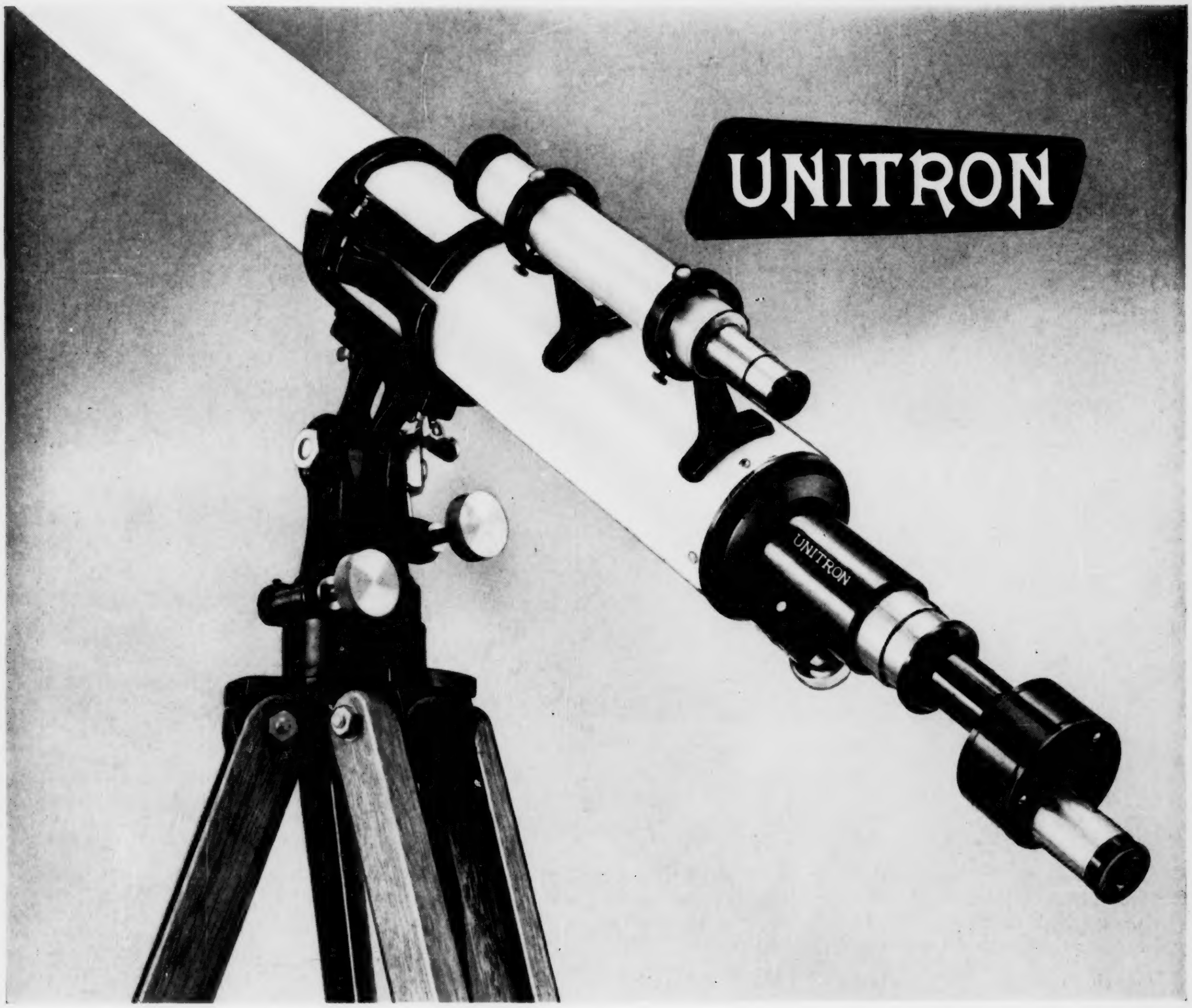

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